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Correspondence.—Wishing to make this JOURNAL a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of those subjects a pleasure or a profession.

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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

The Milwaukee Meeting of the American Gas Light Association.

AMERICAN GAS LIGHT ASSOCIATION,
PRESIDENT'S OFFICE, 716 LOCUST ST.,
ST. LOUIS, MO., Aug. 14, 1905.

The list of papers which are being prepared for presentation to the meeting of the American Gas Light Association, in Milwaukee, in October, is as follows:

"Condensation," by Mr. James S. McIlhenny, Washington, D. C.

"Taxation of Gas Companies," by Mr. Geo. McLean, Dubuque, Ia.

"High Pressure Distribution to Date," by Mr. H. L. Rice, Aurora, Ills.

"Methods of Charging for Gas," by Mr. A. E. Forstall, New York.

"Improvements to Date, Consumers' Meters," by Mr. Charles H. Dickey, Baltimore, Md.

"Municipal Ownership," by Mr. B. F. Lyons, St Louis, Mo.

The meeting on Thursday morning is expected to be opened by a lecture on the "Relativity of Economic Institutions," by Prof. B. H. Meyer, of Wisconsin University. Prof. Meyer writes upon his subject as follows:

"Under this subject I should expect to discuss the functions of the State and their limitation with reference to the nature of government, touching upon the position of the individual in the State, and observing national difference and similarities. In connection with the position of the individual, something may be said with reference to competition and its limitations. Restrictive legislation affecting insurance, stock and produce exchanges, speculation, etc., in the different countries may be briefly outlined as illustrative of 'relativity' in their workings. Finally, the question of public ownership may be discussed in the light of the previously mentioned propositions."

It is expected that Prof. Meyer's lecture will be a great feature of this meeting, and as it is to be followed by a paper upon "Municipal Ownership," by Mr. Lyons, it is to be hoped that the whole subject will make a very attractive meeting. E. G. COWDERY, President.

[OFFICIAL NOTICE.]

Respecting the Official Work of the American Gas Light Association.

AMERICAN GAS LIGHT ASSOCIATION,
SECRETARY'S OFFICE,
530 Broadway, N. Y., Dec. 13, 1904.

To the Members American Gas Light Association: As there seems to be some misunderstanding respecting the standing of the official management of the Association, members will please note that the undersigned is the Secretary of the Association, and that Mr. A. E. Forstall is carrying forward the work of the Practical Class. All correspondence in connection with the Practical Class should therefore be addressed to Mr. A. E. Forstall, 58 William street, and all other matter pertaining to the Association to MR. GEORGE G. RAMSDELL, Secretary, at the above address.

LIBRARY OF CONGRESS
AUG 28 1905
SMITHSONIAN DEPOSIT

[Official Notice.]

Wrinkle Department, Western Gas Association.

Office of Editor, Wrinkle Department,
Western Gas Association,
182 Wisconsin Street, Milwaukee, Wis.,
June 27th, 1905.

To the Members of the Western Gas Association: Your early attention and assistance are earnestly solicited in connection with the above Department for 1906. We are now ready to receive contributions and any device, plan, scheme, wrinkle, suggestion, formula or new method will be warmly welcomed. A full description, with sketch or photo, should accompany each contribution. Give us your help to make the 1906 Wrinkle Department a success. Thanking you in advance for your kind assistance, I remain, Yours truly, B. McAdam, Editor.

[Notice.]

Wrinkle Department, Ohio Gas Light Association.

Ohio Gas Light Association,
Office of the Wrinkle Dept.,
719 Citizens Building,
Cleveland, O., June 13, 1905.

The Wrinkle Department of the Ohio Gas Light Association is now ready to receive contributions for the 1906 collection, and a sketch or description of all devices, formulæ and methods of accomplishing objects pertaining to the gas business, is respectfully solicited.

Please send a written explanation, accompanied by any sketch, photograph or drawing, to the above address, or a description alone will suffice.

Hoping to receive prompt compliance,

Yours very truly, W. E. Steinwedell, Editor.

[Notice.]

Thirteenth Annual Meeting of the Michigan Gas Association.

Office of Secretary, August 28, 1905.

The Thirteenth Annual Meeting of the Michigan Gas Association will be held in Detroit on September 20, 21 and 22. Contrary to the previous custom of the Association, the meeting this year will be extended to 3 days, and those in charge of the programme assure the members that the time will be well occupied with a good list of papers and visiting the points of interest, which are many, around Detroit.

The announcement of headquarters, place of meeting and programme will appear in the next issue. Members of other Associations are cordially invited to meet with us. Henry W. Douglas,
Secretary.

BRIEFLY TOLD.

Death of Mr. George Bray.—Just before going to press a cable dispatch from England brings the sad news of the death of Mr. George Bray, inventor and manufacturer of the well known burner. Mr. Bray has been identified with the gas business for about 45 years. His demise took place on August 22d. Mr. Bray was very prominent among English gas engineers, and was well known to the gas engineers of the world.

Notes—

The funeral of Frank B. Sammis, formerly connected with the Bridgeport (Conn.) Gas Company, who died in California, was held at Bridgeport the afternoon of August 12th. There were a large number of beautiful floral pieces, among which were noticed a large standing wreath of roses, ivy and cycus leaves, from the Bridgeport Gas Company officials; a handsome large wreath from the officers of the First Congregational Church; a wreath of purple asters from the Criterion Club; a large flat bouquet of white asters, "from the crowd;" and large bouquets from numerous others.

The Wausau (Wis.) Gas Company has been incorporated with a capital stock of $200,000 in 200,000 shares. Incorporators, A. E. Smith, J. H. Farrell and R. W. Moore.

[Continued from page 287.]

THIRTEENTH ANNUAL MEETING, PACIFIC COAST GAS ASSOCIATION.

Held In Mechanics Institute, San Francisco, Cal., July 18, 19 and 20, 1905.

First Day—Afternoon Session.

The President—The afternoon session will be opened by a short topic descriptive of the Spangenberg meter, to which I alluded in my address this morning. These meters have been kindly loaned to us by two Eastern manufacturers, and Mr. E. C. Jones has made tests of them and has prepared a short topic. He will now describe the meter. There is no objection to the members coming forward and looking into the meters and have Mr. Jones explain them to you. He would probably like it better if you would.

THE SPANGENBERG METER.

At the meeting of the American Gas Light Association, held in Washington, D. C., October 19, 20, 21, 1904, a paper on the subject of consumers' meters was read by Mr. Brewster H. Spangenberg, Superintendent of Meters for the United Gas Improvement Company, at Philadelphia.

As an introduction to this topic, I would say that every member of this Association should read this excellent paper, and after having read it he should read it again. Mr. Spangenberg has covered in his paper the work performed by the ordinary meters now in use, and the possibilities of important improvements in these meters without great change or expense.

This topic is not intended to simply eulogize the splendid and exhaustive work done by Mr. Spangenberg, but to call to the attention of those among us who have not read his paper that they are in duty bound to do so. My remarks anticipate that everyone present has read the paper, which was published in the *Progressive Age* of December 1, 1904, and the American Gas Light Journal of November 14, 21, 28, December 5, 12, 1904, together with the discussion.

Some of these meters have been made by Messrs. Helme and McIlhenny and Messrs. John J. Griffin & Co., meter manufacturers, both of Philadelphia, and through their kindness we have a sample of the Spangenberg 5-light meter, and another with prepayment attachment. There is nothing particularly new about the prepayment attachment, as there are over 100,000 of this kind now in use. The cash box, however, is new.

The sample 5-light meter was sent out from the East, stripped, and after careful examination of it it was set up and tested and stripped again for your examination. This meter was made by Helme & McIlhenny, of Philadelphia, marked:

5 A 200 cu. ft.
HELME & McILHENNY,
Philadelphia.
700520

The valves are the same size as the valve of an ordinary 20-light meter. The diaphragms are of special size, 8-inch instead of 9-inch, as in the regular 5-light meter. The channel of the inlet is above the table instead of below, and is much larger than usual. The clam-shell is larger and the pockets are larger. The index on this meter registers to 1,000,000 cubic feet, instead of to 100,000 cubic feet, as in the ordinary 5-light meter. The meter has two test dials, each divided into tenths; one registers 2 cubic feet, the other 2-tenths of a cubic foot. The valve arms are shorter and are made of heavier stock. The crankshaft is larger and the kingpost heavier and longer. The flag arms are wider and heavier, and there is more room allowed for packing. The gallery is $\frac{1}{16}$ inch higher than in ordinary meters, and the center stuffing box is arranged so that it can be packed without stripping the meter; that is, taking off the worm and kingpost and the tangent.

This feature alone is valuable, and the foreman of the Oakland meter shop was criticized 10 years ago by one of the most prominent meter manufacturers in this country because he insisted that every meter should be made so that it could be packed without stripping.

The following are brief records of tests of the new meter compared with a few other meters now in use:

July 10, 1905.

H. & McI. (Spangenberg):
Water..... 70° F.
Air..... 74° F.

Tests with 8 burners:

2 feet = 1′ 50″ (O. K.) = 62 feet per hour.

Check.

2 feet = 2′ 51″ (O. K.) = 42 feet per hour.

Open.

2 feet = 23″ (O. K.) = 313 feet per hour.

July 10, 1905.

John J. Griffin. J A 200 feet. No. 800750

Water ..... 70° F.
Air ..... 74° F.

Tests with 8 burners:

2 feet = 1′ 50″ (O. K.) = 62 feet per hour.

16 revolutions as in Helme & McIlhenny.

Check.

2 feet = 2′ 50″ (O. K.) = 42 feet per hour.

Open.

2 feet = 23 2/5″ (—2) 313 feet per hour.

Small flame test.

Meter perfectly tight and registers.

July 11, 1905.

Standard 5-light. No. 47210. 15 revolutions per 2 cubic feet.

Tests with 8 burners.

2 feet — 1′ 55″ — (O. K. — 63 feet per hour.

Check.

2 feet — 2′ 52″ (O. K.) — 42 fe per hour.

Open.

2 feet —37 1/2″ (O. K.) — 192 fe ur.

Small flame.

O. K. perfectly tight.

July 11, 1905.

Pacific Meter Company, 5-light. No. 12599. 12 revolutions per 2 cubic feet.

Tests with 8 burners.

2 feet — 1′ 57″ (O. K.) — 62 feet per hour.

Check.

2 feet — 2′ 49″ (O. K.) — 43 feet per hour.

Open.

2 feet — 45″ (O. K.) — 160 feet per hour.

Small flame. Tight.

July 10, 1905.

Ohio Gas Meter Company, 5-light. No. 5326. 12 revolutions per 2 cubic feet.

Test with 8 burners.

2 feet — 1′ 52 2/5″ (O. K.) — 64 feet per hour.

Check.

2 feet — 2′ 56″ (O. K.) — 41 feet per hour.

Open.

2 feet — 43″ (O. K.) — 167 feet.

Slow 5″ pressure.

Perfectly tight and registers.

Ordinary 5-light meter.

The Spangenberg meter must of necessity be more expensive than the regular 5-light meter, but the greatly enlarged capacity of the meter must be taken into consideration, as the 5-light size will take the place of a 10 or 20-light meter, and as gas consumed per meter is rapidly increasing this meter will care for the increase.

It seems that meter manufacturers have some doubts as to the complete success of Mr. Spangenberg's improvements. To quote one: "The query as to this meter is the effect upon registration, of condensation upon the valve. Our judgment is that it will be better to not introduce these meters generally until some have been used for a year or two."

Another manufacturer says: "As you know, the meter is in the experimental stage, and we are feeling our way with it."

Another large company says: "Everyone in our company is hopeful regarding the new meters, and I know of one other company which will order quite a supply of them as soon as the manufacturer is able to make them."

The improvements made by Mr. Spangenberg are in the right direction, and the development of this meter will be watched with interest.

Discussion.

The President—Gentlemen, this topic is open for discussion. Mr. Jones have you any suggestions or further remarks to make?

Mr. Jones—No, I tried to condense it into that little paper. An examination of the meter, I think, will complete it.

The President—Is there any gentleman who would like to ask Mr. Jones any questions. He has examined the meter in detail and is quite familiar with it. It is a subject of vital importance to gas men as tending to lessen the investment in plant and to increase the efficiency, but one point I think Mr. Jones overlooked is the fact that if this meter meets with universal adoption, it will do away with a great many sizes. Did you cover that Mr. Jones?

Mr. Jones—That was covered in the paper—up to and including 20 lights, there will be 1 meter instead of 4. I would like to say, gentlemen, that in examining this meter, I saw no just cause for the scepticism of the men who are making it. It is one of the best pieces of meter manufacture I have ever seen, and the men who are making it certainly know how to make a meter. The valves will not give any trouble, but in reading a short topic on the meter, I thought best to give you the worst, as well as the best. I think there is no ground whatever for the sceptical remarks of the gas meter manufacturers.

The President—Do you recall, Mr. Jones, the price of the meters?

Mr. Jones—That was stated; I believe the list price is $11.50.

The President—That is the cost of the meter which would take the place of all sizes up to what?

Mr. Jones—There is nothing smaller than a 5-light meter used in any of the principal Eastern cities to-day. This meter will take the place of the 3, 5, 10 and 20-light.

The President—This new meter will take the place of the 3, 5, 10 and 20-light, so that as compared with the present 10 and 20-light meters, there would be a reduction in price?

Mr. Jones—Yes, sir.

Mr. Valentine—I would like to ask Mr. Jones if the valves are the same shape as in the ordinary square meter. Are they D-shaped valves?

Mr. Jones—The valve is practically the same shape as in the ordinary meter.

Mr. Lloyd—Do I understand you to say that the diaphragms are a great deal smaller in this meter?

Mr. Jones—One inch smaller in diameter.

Mr. Lloyd—Wouldn't that make the action quicker?

Mr. Jones—I think it is about 3 revolutions in 2 feet, or something like that.

Mr. Lloyd—Well, wouldn't that have a tendency to close the diaphragm quicker?

Mr. Jones—Not if the diaphragm is properly protected, and is made right. Right here, I would like to criticise a meter which is used extensively in this country. The meter has what is known as a telescoping device to give greater breathing space to the diaphragm of the meter. In order to bring about this telescoping effect, it is necessary to have 2 rings of tinned iron, one passing over the other. The diaphragm in passing by the edge of the inside ring, cuts the leather so that upon stripping a meter, which is found not to register correctly, you will find that the diaphragm has been almost cut away by passing over the rough edge of the inner ring of the telescoping arrangement. I would not feel at liberty to make mention of this if it were not possible to remedy it at small cost. I believe the edge can be turned over so that the leather on the diaphragm will not wear.

Mr. Clement—In my experience with the square meter, those rings are made the same size, and when not properly adjusted, you will find in larger meters, say over 20 light, that very often they cause the meter to stop. I have found the greatest trouble where the rings are the same size. That is a defect in the meter—where both rings are the same size.

Mr. Jones—I think you will be interested in examining these Spangenberg meters—all of you.

The President—Are there any more questions to be asked?

The Secretary—I would like to ask, Mr. Chairman, whether or not it was the intention, when these meters came into general use, to change the nomenclature of meters, designating them by some other means, or as we have in the past, as 3, 5, 10 and 20-light. Are they not to be designated by their capacity to pass gas?

Mr. Jones—I believe it will be necessary to do it in that way. We all know that we can put 20 feet of gas through a 2-foot lava tip, we can put 40 feet of gas through a 4-foot lava tip without crowding it, and it became necessary to designate the size of lava tips, and I understand that $\frac{2}{10}$ of an inch water pressure was taken as a standard under which to test tips. The same might be said of the gas meter of to-day—the old fashioned meter, 3, 5, 10 and 20-lights. I think this new meter is rated by the cubic feet per hour. The meter is marked 5 9—200 cubic feet.

The President—In other words, there is a designating number in addition to the customary number, and the capacity.

Mr. Jones—The approximate capacity.

The President—Gentlemen, the next paper will be that prepared by Mr. George Kirk, of Oakland, entitled

HOUSE PIPING.

I have been requested to say a few words on house piping. I can only give you my experience with gas pipe in houses as I have found it

during the last 30 years, as Inspector for the Oakland Gas, Light and Heat Company. During that time I have had considerable experience with gasfitters, whom I find as a rule need watching, both in regard to the size of pipe and the manner of placing same in the house.

As a great deal of the work of cutting the pipe and putting on the fittings is done by boys who are always looking for an easy job, much small pipe, rather than larger pipe, gets into the work, if the fitter can get it in and covered before the inspector sees it, for when the plumber gets his certificate there his trouble ceases and the gas man's trouble as a rule begins, and plumbers use all the talent they have to fool the inspector in such cases.

I have found them resorting to all kinds of tricks known to the trade to get the pipe so that it would stand the test. I will only mention one or two, as I know most of you gentlemen have had as much or more experience than I have had.

In some cases I have known them to fill the pipe with salamoniac water, muriatic acid and the like, to rust the pipe in hopes of stopping the leak and keep it tight long enough that the job may pass inspection, We know that pipes at best rust soon enough without any aid from the plumbers.

On account of the stoppages in pipes, caused by rust and cendensations, some years ago the Oakland Company changed the rules governing the size of pipe, increasing same very materially from the size then in use, and since then has had little or no trouble.

Three-eighth inch pipe is used only for brackets or side lights. No horizontal pipe less than ½ inch and house riser less than ¾. I find that if pipe less than the size specified in our rules is used, we are liable to have more or less trouble with stoppages in the same, caused by the following reasons:

The majority of gasfitters use the 3-wheel cutter to cut the pipe, which leaves a burr inside at each end and diminishes the size of the pipe. The gasfitter then is using lead or cement in his fittings, places the same inside of the coupling or fitting and not on the threads, as should be done. The result of this is that more or less of the material is forced inside and against this burr, leaving a very small opening in the pipe.

Although this is the time of high pressure and small pipes for street mains, I cannot see where we can lessen the size of house piping with any assurance of satisfaction to the consumer. However, it will always be necessary to use a governor and low pressure on the house pipes, as very few if any gas fixtures would stand 1 pound pressure.

In considering the placing of house pipe for either illuminating or fuel purposes, the prime object to be sought is the safety of the occupants.

Under this heading comes the question of the use of black or galvanized fittings. I consider the use of black iron fittings on gas pipes concealed within the walls or under the floors of a building a constant menace to the general public, as black iron fittings are known to have more or less sand holes in them, and sometimes very large ones at that. Now, what is the result? When the plumber finds a fitting with one of these large sand holes in it he is not going to cut it out, for it will probably cost him a couple of dollars to do so. The result is that he resorts to the use of gasfitters' cement to plaster it up, this being the easiest and cheapest way out of it for him. The inspector will not be able to see same for the simple reason that the plumber knows how to cover it up, so that it cannot be detected by the most critical eye. From my experience I am sure there should be rigid rule against using gasfitters' cement under any circumstances on concealed pipes. Now, what is the result? In a few years the action of the chemicals in the gas will soften that cement, and there is a leak under the floor or in the wall. It is for this reason that I advocate the use of galvanized fittings exclusively for house gas pipe.

I also suggest, from the standpoint of safety, that there should be a shut-off in the main pipe on the first floor and it be marked as the "gas stopcock." This, I think, would be the means of averting a great many accidents with gas.

Such an occurrence happened in Oakland a few days ago, when a man got up about 6 o'clock in the morning, and going into the hall found the place full of gas. He naturally tried the gas fixtures to see if any were loose, probably not knowing where to shut off the gas. The broken fixture was found, and it was remembered that in carrying out a trunk the night previous this fixture had been struck by the trunk, causing a bad leak near the wall. The fixture was a combination gas and electric, and when the gentleman endeavored to move the fixture the electric wire emitted a spark that exploded the gas which had accumulated during the night.

Now, I believe that if there had been a stopcock on the main pipe, easy of access, and known to him, this accident would not have occurred.

Discussion.

The President—The topic is before you for discussion. The subject is very close indeed to the daily work of the gas man. Mr. Kirk's observations seem to be well timed and thoroughly practical. I hope his paper will receive full discussion. Mr. Valentine, you should be able to tell us something about house piping.

Mr. Valentine—I have been very much interested in Mr. Kirk's paper, and I agree with him in every statement he has made, but there is one point that occurs to me in regard to the inspection of piping. If I am right, a gas company cannot refuse to introduce gas into a building, no matter what the conditions are. I may be mistaken in the statement, but it seems to me that something should be done by which a gas company can have every privilege of refusing to supply gas to a house, unless it is tested by the inspector. This occurs to me as being a subject of a great deal of importance to gas men. My experiences have been very similar to those of Mr. Kirk as to the leakage of fittings, but I have always found that plumbers will resort to even sealing wax to close up stoppages, and fix the pipe up before the inspector can get there.

Mr. Jones—Mr. President, I find in testing house piping that carpenters oftentimes drive nails through the piping, and I would say in reply to Mr. Valentine, that no gas company has a right to turn on the gas until the house piping has been properly tested. Referring to the Spangenberg meter it has a dial, which, instead of registering 2 feet per revolution, has a secondary dial which registers $\frac{2}{10}$ of a foot per revolution, and is so sensitive that the slightest leak will be detected, and the gas company would, therefore, be protected in that way.

The Secretary—The question Mr. Valentine raises permits of but one answer. Under the law of the State of California a gas company has no right, as he says, to refuse to turn on the gas upon the applicant applying and complying with the rules of the gas company with respect to the same. On the other hand, the gas company is under no obligation to inspect the gas pipe in houses, and cannot be held responsible for any leaks in the piping where the inspection of house piping is gratuitous on the part of the gas company. A great many companies do not inspect piping at all, but turn on the gas, and if a leak is discovered, as Mr. Jones says, upon turning on the gas, it can be turned off and notice served upon the confumer that there is a leak, but that is your only remedy and recourse. I think the question of inspection of piping in houses has been carried very much to the extreme, because it has cost a great many thousands of dollars, during a great many years, and has accomplished practically no good, exeept to antagonize the gasfitters and force them in the end to resort to subterfuge to cover up bad work. The question of leakage in a building through defective work done by plumbers is an immaterial matter. It does not amount to enough to justify the cost or expense of a gratuitous inspection which is being indulged in, and I for one see no object in doing it.

Mr. Calquhoun—We use that system in Fresno very rigidly. We find a great many fitters that come from other places, that simply know nothing about gasfitting, and when it comes to putting in work, they use wax and such things as that which are not safe at any time, and which do not do a bit of good. Another point that ought to be gone into a little more, is that of gas fixtures. There are few of them that will even hold gas pressure now. You put them in and they leak all over, and we are immediately called upon to test them. I think there should be some method of putting good gas fixtures on.

Mr. Newbert—I understand, Mr. President, from Mr. Britton's remarks, that if the owner of a building is willing to accept the piping after you have reported to him any defects, then there is no moral responsibility resting upon the gas company.

The Secretary—There is not in any event, Mr. Newbert.

The President—My personal practice has been to issue to all architects and builders of houses, a set of piping rules, with the suggestion that they be followed, offering to test the house piping for them, if they wished, at no expense. It is not very often that we are called upon to do it, but we stand ready to do it, and strongly recommend the inspection of the piping. I think that releases us from even a moral responsibility.

Mr. Campbell—I think the gentlemen speaking about fixtures has hit upon the main trouble of most of the leaks, because the pipes are invariably tested with the caps on, and when you talk about cement being used, there is more cement used in one fixture than a plumber will use in a whole house. The main trouble we have here in San Francisco (I know 9 leaks out of every 10) is on account of poor fixture work. They send out a lot of cheap truck here, and put in boys to slap them together, and send them up to get measurements and put them up. The

joints are not screwed on tight, and if they do lead them, they put so much on that they plug up the arms, and that is the trouble with the fixture.

Mr. Grover—In case of a leaky lot of house piping or fixture, resulting in accident or damage, where does the responsibility come in?

The President—Not being a lawyer, I cannot say.

Mr. Grover—It seems to me that that is a mighty pertinent question.

The President—I imagine that there would be no responsibility attaching to the gas company.

Mr. Grover—Wouldn't that settle the question of whether or not the company had the right to test the pipe? If the burden of responsibility rested with them, they should certainly have the right to reject the piping.

The President—No, I do not believe so.

Mr. Cressey—I notice the court decisions in the east are all against the gas company.

The President—In house piping.

Mr. Cressey—Yes, sir; I have read a number of decisions on this matter, and that is the reason why we have taken the precaution we have.

The President—I am inclined to think that if you took your case under appeal to a higher court, you will find that no obligation rests with the company.

Mr. Cressey—That was in Ohio and Pennsylvahia.

The President—Was that a Supreme Court decision, or a lower court.

Mr. Cressey—A lower court.

The President—Well, you might expect anything from a lower court.

Mr. Kirk—In Oakland, nearly all of the specifications of the buildings have a clause in them that the piping must be inspected by the Oakland Gas Light and Heat Company, and have a certificate from the inspector before the building is accepted. Now, a great many of the gasfitters (not all of them, there are some honest gasfitters, but a great many of them) try their best to under-bid each other. Therefore they try to do their work just as cheap as they can, and I have found in a great many places where they had fitted up a whole house with ⅜-inch pipe. Of course, it wasn't inspected, but the whole trouble comes in when they want the house all lighted up; for instance, 7, or 8, or 10-room houses, and they have the whole house lit up. They can't get gas, there is no pressure, and you can't get it when the pipe in the whole house is too small. I think it is one of the things to see that the pipe is of the proper size.

Mr. Lloyd—Do you recommend galvanized fittings for gas. I do not know as it would make any difference with oil gas, but with coal gas, wouldn't the gas have an effect on the galvanized fittings? We had an experience at Sacramento at one time. There was a 1¼-inch galvanized pipe in the State Capitol. A length of pipe ran horizontally right under the floor, and that pipe was always stopping up. We finally cut the pipe out and found that it contained a dust or powder which was very fine. We removed and cleaned the pipe out. I should judge that it contained a hatful of this dust, and a year or so afterwards I had the same trouble. We took and disconnected this length of pipe again and found the same trouble, the same fine dust, very fine. You could blow it away. That length of pipe has been removed, and a length of black iron pipe put in, and we never had any more trouble with it. At that time we made coal gas in Sacramento. I have never come in contact with anything of that kind in oil gas, and when you recommend galvanized iron fittings, I do not know but what where coal gas is used it might cause the same trouble.

The President—Don't you think, Mr. Lloyd, that the class of galvanizing may have had something to do with it? How many times did you replace the galvanized pipe?

Mr. Lloyd—We did not replace it the first time—we just took it out and cleaned it and put it back.

The President—You did not try a second piece of galvanized pipe?

Mr. Lloyd—No.

The President—Are there any further remarks?

Mr. Valentine—In regard to the inspection of buildings, there is a movement on foot in Sacramento which I think is coming to a head, and which I think will be a very good thing for the gas men. That is the appointment of a city inspector, to inspect all gas piping, and no job to be accepted without a certificate from him.

The President—Does that go to the extent of house piping? It seems to me that that would come within the province of the building inspector.

Mr. Valentine—This is the plumbing inspector who is to take up that as a part of his work. In regard to the dust that Mr. Lloyd speaks of, I would like to ask him if that was in any way different from what we sometimes get in ordinary black pipe.

Mr. Lloyd—This was a white dust—just like dust.

Mr. Valentine—It might have been a poor quality of galvanizing—it may have peeled off on the inside.

The President—There is no question but what Mr. Lloyd is entirely correct in his statements that the trouble has been met with in galvanized pipes. I have seen the same thing myself, although I have never attempted to find out the cause of it. Possibly Mr. Jones could enlighen us on that subject.

Mr. Jones—I have had no experience with galvanized pipe being attacked by gas of any kind. I doubt very much whether that was the cause of it. I would like to say that in many instances pipes are put into houses without having the scales shaken out of them. Every length of pipe should be hammered and turned on end and hammered, and looked through, before it is put into a building. Oftentimes the scales from the whole fittings in a building, and every pipe in a building, will assemble itself at one convenient place, and might perhaps stop up the pipe at that place.

The President—If there are no further remarks, gentlemen, we will pass to the next paper, which will be that prepared by Mr. Rix, entitled,

THE COMPRESSION AND TRANSMISSION OF ILLUMINATING GAS.

I wish to say, gentlemen, that Mr. Rix is one of our new members, one of the babies of the Association, and he has done that which we sometimes have great difficulty in getting some of our older members to do—he has come forward and put his shoulder to the wheel. Mr. Rix. (Applause.)

The subject of illuminating gas compression is almost a new one with me, and the nature of the gas is so entirely different from that of air that I have been obliged to consider the question mainly from the theoretical standpoint, backed up by a few indicator cards, which have been furnished me by gas compressors. But I can assure you that all of the data which I shall give you is eminently practical, because I have eliminated all of the small variables that are important from a chemical standpoint, but which the advancing piston of a compressor cylinder takes little heed of.

I am not concerned about the candle power or the commercial utility of a gas, but simply with its weight and composition, and what may happen to it after it leaves the compressor cylinder is not the province of this paper.

All gases are sponge-like, in that they hold various vapors from water vapor to carbon vapors, which they lose to a more or less extent when the sponge is squeezed as in the act of compressing in a cylinder, and what is squeezed out and how much of it is not essential to our discussion, and lies better in the realm of the technical gas engineer.

I have assumed, however, that inasmuch as when we compress a gas the temperature rises in a fixed ratio to the pressures, that there is no direct tendency for a gas to change its physical condition in the compressing cylinder, for an added temperature gives an added capacity for saturation, and this probably increases in about the same ratio as the volume diminishes during compression. So that for commercial purposes I cannot be far wrong in assuming the physical condition of the gases as constant during the range of pressures that will be ordinarily met.

All phenomena of compression and expansion of gases is intimately associated with temperature; in fact, the power to compress any gas in foot pounds is simply the difference in temperature between the gas before and after compression, multiplied by its weight in pounds, by its specific heat, and then by Joules equivalent to convert heat units to foot pounds. Expressed algebraically, this equation is—

$$L = J\,W\,C_p\,(T - T_o)$$ where
J is Joules equivalent = 772,
W = the weight in pounds avoirdupois to be compressed.
C_p is the specific heat of the gas at constant pressure.
T_o is the initial absolute temperature.
T is the final absolute temperature.
L is the work expressed in foot pounds.

This is the general equation for the compression of any gas.

In glancing at this equation, the first stumbling block we strike is C_p, the specific heat of the gas at constant pressure, and this must be first determined. After that, we must discover some means of finding T the final temperature.

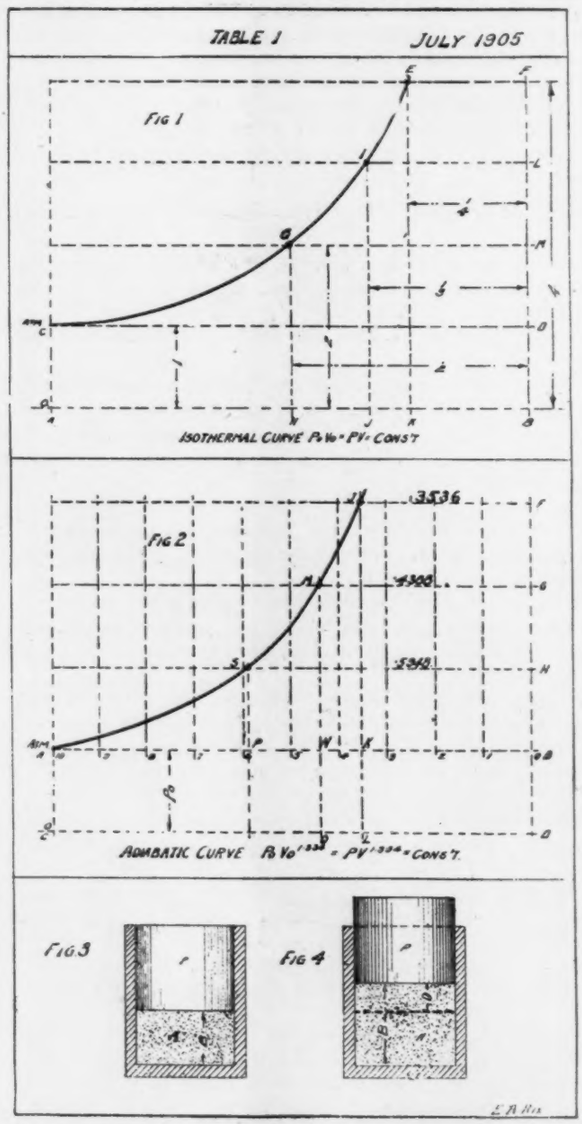
To anticipate a little, it may be stated here that these temperatures are all functions of the ratio of the specific heats of gas at constant pressure, and at constant volumes.

It is then our first duty to understand about these two specific heats and to know how to determine them for any gas, and the rest is simple.

The specific heat of any substance is the amount of heat 1 pound of that substance will absorb to raise its temperature 1° F., the specific heat of water being 1.

When a gas is heated two different results may be obtained, depending upon whether the gas is allowed to expand and increase its volume when heated, the pressure remaining constant, or whether the air is confined and the volume remain constant, and the pressure increasing. The amount of heat to raise the temperature of a gas 1° under these two conditions is different, therefore the specific heat is different. The former is called specific heat at constant pressure and the latter specific heat at constant volume.

Referring to Table 1. Fig. 3, if we have a cylinder A, containing 1



pound of gas at atmospheric pressure, and a piston P, without weight, but having an area of 1 square foot, and heat the gas until the temperature has risen 1° F., the gas will have expanded by the small amount d, as in Fig. 4, and raised the piston. This expansion is 1/460 of the original volume, at 0° F.

It is evident that inasmuch as the piston has raised and displaced the atmosphere, that work has been done, which must have absorbed heat in addition to that necessary to raise the temperature of the air 1°. If the piston was fastened, as in Fig. 3, the gas would have required just that less heat to raise it 1° as was required to lift the piston through the distance d = 1/460 of its volume. The amount of heat required in the first instance is called specific heat at constant pressure, and the latter at constant volume.

Specific heat of most gases at constant pressure has been determined by Regnault and others experimentally, and the symbol is C_p.

The amount of work done in lifting the piston through the distance d is measured the same as the work done by any piston by multiplying the pressure on the piston by the distance passed through. The area multiplied by the distance is the volume, which may be expressed by V. The distance d is 1/460 at 0° F., or may be expressed by $\frac{1}{T}$

Let P be the pressure, and R, the foot-pounds of work done, then $\frac{VP}{T} = R$ and this is called the Simple Gas Equation, and about it hangs many important deductions.

R is a constant for any gas, because inasmuch as the gas expands uniformly for each 1° of heat, any volume as V_1 multiplied by its corresponding P_1 and divided by its corresponding temperature T, will equal R, or to put it algebraically,

$$\frac{VP}{T} = \frac{V_1 P_1}{T_1} = \frac{V'' P''}{T''} = R = \text{Constant}$$

R being always in foot-pounds, if we divide it by Joules' equivalent 772, which is, as you know, the amount of foot-pounds equal to 1 heat unit, and which is always denoted by J, we shall have the amount of heat units that were converted into work to raise the piston, and this amount of heat, we know, must be the difference between the specific heat at the constant pressure and the specific heat at constant volume,

or,
$$\frac{R}{J} = C_p - C_v$$

from which we have
$$C_v = C_p - \frac{R}{J}$$

an equation from which the specific heat at constant volume may be determined for any gas within the limits of its stability, and certainly within the commercial pressures you are likely to encounter.

For a perfect gas, these specific heats are practically constant; that is, they are not affected by pressure or temperature, but so far hydrogen and air appear to be nearer than any other gases. CO and CO_2, which are inferior components of illuminating gas, as it is now made, shows the greatest deviation, but not enough to render their vagaries of moment in the consideration of the power question, consequently all the following data has been calculated on the basis of the simple gas law.

$$\frac{PV}{T} = R = \text{Constant.}$$

As an example showing how to calculate the specific heat at constant volume, let us take $C_2 H_4$. I have selected this gas because it caused me a great deal of work and nearly caused me to abandon this paper because I could not check any of the calculations by using the value assigned by Regnault and copied evidently by all others down the line.

Upon applying the simple gas equation to the Regnault value I found that it was wrong, and it will be interesting no doubt to make the calculations here, and thus make them serve the double purpose of showing how to determine the specific heat at constant volume and to point out the error.

Regnault gives the C_p of $C_2 H_4$ to be .404, and C_v to be .173. The weight per cubic foot to be .0780922, or 12.8 cubic feet in 1 pound at 32° F.

If, now, 1 pound, or 22.30 cubic feet, be heated to 1° F. and allowed to expand, the simple gas equation

$$\frac{PV}{T^\circ} = R \text{ will give at } 32^\circ$$

$$\frac{22.39 \times 144 \times 12.8}{492} = R = 55.$$

Fifty five foot-pounds of work has been performed by the gas in expanding against the atmosphere; to convert this into heat units we divide by Joules equivalent 772.

$$\frac{55}{772} = .07124 \text{ units of heat.}$$

Inasmuch as
$$C_v = C_p - \frac{R}{J} \text{ and } \frac{R}{J} = .07124$$

we have $C_v = .404 - .07124 = .3327$, instead of .173 as determined by Regnault. The ratio between the two specific heats forms the basis for all the calculations for the relations between pressure, volume and temperature in compressing gas, and that is why we must be particular about these specific heat factors.

$\frac{C_p}{C_v} = y$, which we shall discuss further on, and which is brought in now simply as additional proof about the figures which we have just obtained for $C_2 H_4$.

For C_2 H_4, using Regnault's values, we have

$$y = \frac{.404}{.173} = 2.33$$

for our values

$$y = \frac{.404}{.3327} = 1.214.$$

In reading a new book by Travers on the study of gases (page 275), he gives some very interesting calculations to show the limiting values of $\frac{C_p}{C_v}$ or y.

His conclusions are that for a monoatomic gas within the limits of the simple gas equation $\frac{PV}{T^\circ} = R$, the values of $\frac{C_p}{C_v}$ can never exceed 1.667, and the value for a diatomic gas should range about 1.4 and the polyatomic gases still less, until we reach the value of 1, where, of course, there should be no expansion work at all when heat was applied.

We can see, therefore, that the value $\frac{C_p}{C_v}$ of 2.33 from Regnault's values is an impossibility, the maximum possible value being only 1.667, and C_2 H_4 being the polyatomic gas, its value would be less than 1.4, all of which indicates that our figures $\frac{C_p}{C_v} = 1.214$ are approximately correct.

It will now be necessary to apply our understanding of these principles and try and determine the values of the specific heats for illuminating gas. There seems to be plenty of data about the specific heat at constant pressure for gas mixtures, but nothing about the specific heat at constant volume.

Reference is now made to the Tables 2, 3, 4, 5, 6, 7 and 8, which show the composition and heat properties of seven different gases and the methods employed in determining the weights, specific gravities and specific heats.

Column 1 is the chemical symbol for the different components.

Column 2 is the percentage by volume of the different components.

Column 3 gives reliable weights per cubic foot.

Column 4 gives the specific heat of each component gas as determined by Regnault and others.

Column 5 gives the product of the different percentages of the component gases and their weights per cubic foot, or Column 2 multiplied by Column 3. The total sum divided by 100 gives the weight of the gas per cubic foot.

Column 6 gives the product of Column 4 and Column 5 for specific heat, being a weight function. We must, in order to get the specific heat of the compound gas, take into consideration not only the percentages of the component parts, but the weights as well, and also the specific heat of each component. The sum of the products in column divided by 100, and then by the weight of 1 cubic foot of the compound gas, will give the specific heat at constant pressure C_p.

Column 7 gives the calculations to find the specific heat at constant volume and also R and $\frac{C_p}{C_v}$ or y for each gas, and also various factors of y which we will find useful later.

TABLE 2 CRUDE OIL GAS MANUFACTURED AT OAKLAND CAL. BY CALIFORNIA GAS AND ELECTRIC COR JUNE 1905

1	2	3	4	5	6	7
SYMBOL	PERCENT OF VOLUME	WEIGHT PER CUBIC FOOT 32° FAH	C_p	PERCENT OF VOLUME X WEIGHT PER CU. FT.	PERCENT OF VOLUME X WEIGHT PER CU. FT. X C_p	
C_2 H_4	7	.0780922	.404	.54664	.220842	$\frac{V_o P_o}{T_o} = R = \frac{144 \times \frac{1}{.0323577} \times 14.7}{492}$
CH_4	28.3	.044668	.5329	1.26390	.749350	
H	51.3	.005594	3.409	.29032	.989700	$R = \frac{30.36 \times 144 \times 14.7}{492} = 133.2$
CO	5	.0780922	.2479	.39045	.096793	
CO_2	3	.122760	.217	.36828	.079867	$C_v = C_p - \frac{R}{J} = .6884 - \frac{133.2}{772} =$
N	4.8	.078371	.2438	.37618	.091711	$= .6884 - .1725 = .5159$
O		.098180	.21751			
	100.00			3.23577	2.221563	$\frac{C_p}{C_v} = \frac{.6884}{.5159} = 1.334 = Y$
				= .0323577	.022275 ÷	
				PER CUBIC FOOT.	.0323577	$\frac{Y}{Y-1} = 4$ $\frac{Y-1}{Y} = .2504$
					6884 = C_p	

NOTE - SPEC GRAV .402 OBSERVED. SPEC GRAV .4008 CALCULATED

$L = 8467\left(\frac{T}{T_o} - 1\right)$ FOOT POUNDS

E.A. RIX.

TABLE 3 CRUDE OIL GAS MANUFACTURED AT FRESNO CAL. BY CALIFORNIA GAS AND ELECTRIC COR JUNE 1905

1	2	3	4	5	6	7
SYMBOL	PERCENT OF VOLUME	WEIGHT PER CUBIC FOOT 32° FAH	C_p	PERCENT OF VOLUME X WEIGHT PER CU.FT.	PERCENT OF VOLUME X WEIGHT PER CU.FT. X C_p	
C_2 H_4	5	.0780922	.404	.39046	.157745	$\frac{V_o P_o}{T_o} = R = \frac{144 \times .028453 \times 14.7}{492}$
CH_4	29.7	.044668	.5329	1.32640	.186420	
H	55.4	.005534	3.409	.30968	1.055700	$R = \frac{35.146 \times 144 \times 14.7}{492} = 151$
CO	5	.0780922	.2479	.39045	.096793	
CO_2	1	.1227603	.217	.12276	.026577	$C_v = C_p - \frac{R}{J} = .7724 - \frac{151}{772} = .7724$
N	3.9	.078371	.24380	.30564	.074515	$-.1956 = .5768.$
O		.083180	.21751			
	100.00			2.84539	2.19775	$\frac{C_p}{C_v} = \frac{.7724}{.5768} = 1.339 = Y$
				= .028453	.0219775 ÷	
				PER CUBIC FOOT.	.028453 =	$\frac{Y-1}{Y} = .253$ $\frac{Y}{Y-1} = 3.95$
					.7724 = C_p	

NOTE - SPEC GRAV .353 OBSERVED. - SPEC GRAV .3524 CALCULATED

$L = 836\left(\frac{T}{T_o} - 1\right)$ FOOT LBS.

E.A. RIX.

TABLE 4 CRUDE OIL GAS MANUFACTURED AT HAPPY VALLEY CAL. BY CALIFORNIA GAS AND ELECTRIC COR JUNE 1905

1	2	3	4	5	6	7
SYMBOL	PERCENT OF VOLUME	WEIGHT PER CUBIC FOOT 32° FAH.	C_p	PERCENT OF VOLUME X WEIGHT PER CU.FT.	PERCENT OF VOLUME X WEIGHT PER CU.FT. X C_p	
C_2H_4	10·3	·0780922	·404	·80435	·324957	$\frac{V_o P_o}{T_o} \cdot R = \frac{144 \times \cancel{.0374432} \times 14.7}{492}$
CH_4	26	·044668	·5329	1·16136	·688530	
H	46	·005594	3·409	·25732	·877210	$R = \frac{26.70 \times 144 \times 14.7}{492} = 114.8$
CO	6	·0780922	·2479	·46855	·116150	
CO_2	3	·1227603	·217	·36828	·073167	$C_v = C_p - \frac{R}{J} = ·6015 - \frac{114.8}{772}$
N	8·4	·078371	·24380	·65831	·160840	$= ·6015 - ·1487 = ·4528$
O	·3	·089180	·21751	·02675	·005818	
	100·00			3·74492	2·252672	$\frac{C_p}{C_v} = \frac{·6015}{·4528} = 1·328 = Y$
				= ·0374492	·0225267	
				PER CUBIC FOOT	÷ ·0374492	$\frac{Y-1}{Y} = ·247 \quad \frac{Y}{Y-1} = 4·054$
					= ·6015 = C_p	
						$L = 8573\left(\frac{T}{T_o} - 1\right)$ FOOT LBS

NOTE SPEC GRAV 464 CALCULTION

E.A.Rix

TABLE 5 CARBURETTED WATER GAS PURIFIED SAN FRANCISCO. GAS CO NORTH BEACH DEC. 14TH 1897

1	2	3	4	5	6	7
SYMBOL	PERCENT OF VOLUME	WEIGHT PER CUBIC FOOT 32° FAH	C_p	PERCENT OF VOLUME X WEIGHT PER CU.FT	PERCENT OF VOLUME X WEIGHT PER CU.FT X C_p	
C_2H_4	9·2	0780922	·404	·72842	·29427	$\frac{V_o P_o}{T_o} = R = \frac{144 \times \cancel{.04671} \times 14.7}{492}$
CH_4	22·2	·044668	·5329	·99145	·58780	
H	35·1	·005594	3·409	·19610	·66850	$R = \frac{21.4 \times 144 \times 14.7}{492} = 92.02$
CO	25·2	·0780922	·2479	1·96786	·48781	
CO_2	3	·1227603	·217	·36810	·07987	$C_v = C_p - \frac{R}{J} = ·47 - \frac{92.02}{772}$
N	4·3	·078371	·24380	·38361	·09352	$= ·47 - ·1192 = ·3508$
O	·4	·089180	·2175	·03564	·00772	
	100·00			4·67124	2·21949	$\frac{C_p}{C_v} = \frac{·47}{·3508} = 1·34 = Y$
				·04671	·0221949	
				PER CUBIC FOOT	÷ ·04671	$\frac{Y-1}{Y} = ·254 \quad \frac{Y}{Y-1} = 3·97$
					= ·47 = C_p	
						$L = 8403\left(\frac{T}{T_o} - 1\right)$ FOOT LBS

NOTE SPEC GRAV ·578 AT 32°

E.A.Rix.

TABLE 6 COAL GAS MANUFACTURED AT HUDSON MASS. ANALYZED BY STATE INSPECTOR OF GAS

1	2	3	4	5	6	7
SYMBOL	PERCENT OF VOLUME	WEIGHT PER CUBIC FOOT 32° FAH	C_p	PERCENT OF VOLUME X WEIGHT PER CU.FT	PERCENT OF VOLUME X WEIGHT PER CU.FT X C_p	
C_2H_4	5·31	·0780922	·404	·46151	·18644	$\frac{V_o P_o}{T_o} = R = \frac{144 \times \cancel{.03292} \times 14.7}{492}$
CH_4	37·31	·044668	·5329	1·69306	1·00377	
H	45·52	·005594	3·409	·25463	·86793	$R = \frac{30.4 \times 144 \times 14.7}{492} = 130.72$
CO	5·60	·0780922	·2479	·43730	·10840	
CO_2	1·07	·1227603	·217	·13128	·02847	$C_v = C_p - \frac{R}{J} = ·683 - \frac{130.72}{772} =$
N	3·84	·078371	·24380	·30094	·07118	$= ·683 - ·1693 = ·5137$
O	·15	·089180	·21751	·01337	·00230	
	100·00			3·23209	2·24309	$\frac{C_p}{C_v} = \frac{·683}{·5137} = 1·33 = Y$
				= ·03292	·02243	
				PER CUBIC FOOT	÷ ·03292	$\frac{Y-1}{Y} = ·248 \quad \frac{Y}{Y-1} = 4$
					= ·683 = C_p	
						$L = 8467\left(\frac{T}{T_o} - 1\right)$ FOOT LBS

NOTE SPEC. GRAV ·408

E.A.Rix

Table 9 concentrates Table 2 to 8, so that we may study them easier.

You will note that our results cover quite a field, taking in California fuel oil gas, Massachusetts coal gas, Indiana natural gas, California natural gas, and California carburetted water gas, and after carefully studying their heat and power properties, as shown in Table 9, I have selected the fuel oil gas made in Oakland as having the best average properties for the purposes we have in view, and particularly as fuel oil gas is the one you will probably have most to deal with.

We may, therefore, consider our subject as having for a basis a gas with the following properties at 32° F.

Weight per cubic foot, .0323577.

Cubic foot in 1 pound avoirdupois, 30.98.

Specific gravity, .4008.

$$C_p = .6884.$$
$$C_v = .5159.$$
$$y = 1.334.$$
$$\frac{y-1}{y} = .25.$$
$$\frac{y}{y-1} = 4.$$
$$R = 133.2.$$
$$L = 8{,}467\left(\frac{T}{T^o} = 1\right)$$

A cubic foot of gas varies in weight according to the altitude or pressure, and also arcording to the temperatures. The law of this variation is expressed as follows:

Having given the weight of a gas for any temperature, or any pressure, then the weight at any other temperature or pressure will be as the ratio of absolute temperature or pressure, or

$$W' = W\frac{T}{T^o} \text{ or } W\frac{P}{P^o} \text{ where}$$

W = known weight.

T^o and P^o the known temperature or pressure and W' the desired weight.

For example—Our standard gas weights at sea level, or 14.7 pounds absolute pressure, and 32° F., .03235 pounds per cubic foot; at 20 pounds gauge, or 34.17 pounds absolute, a cubic foot would weigh $.03235 \times \frac{34.17}{14.7} = .03235 \times 2\ 36 = .076346$ pounds, and at 60° F. instead of 32° F., this cubic foot would weigh $.076346 \times \frac{520}{460} = .0819$ pounds. 460 being the absolute temperature of O^o and 520 the absolute temperature of 60° F. = 460 + 60 = 520.

Altitudes are nothing more or less than pressures less than sea level, and are treated just the same as pressures above the normal atmospheric.

Thus at 5,225 feet the absolute pressure is 12.044, consequently, as gas at this altitude would weigh $\frac{12.044}{14.7}$ times the weight at sea level.

For your convenience it may be well to add here that when the barometric pressure is known, the atmospheric pressure is found by multiplying the barometric pressure by .4908, or $P^o = B \times .4908$.

For example—When the barometric is 29.92 the atmospheric pressure is 29.92 × 4,908, or 14.7, the normal sea level pressure.

To find the atmospheric pressure when the altitude in feet is given, we have

$$P = 14.72 - \frac{57{,}000\,N - N^2}{100{,}000{,}000} \text{ in which}$$

N = altitude in feet.

For example—To find the atmospheric pressure at 10,000 feet we we have

$$P^o = 14.72\,\frac{57{,}000 \times 10{,}000 \times (10{,}000)^2}{100{,}000{,}000} \text{ or}$$

$P^o = 14\,72 - 4.7 = 10.02$, the atmospheric pressure required.

The foregoing rules will be all that is necessary to calculate all variations of weights due to pressure, altitude or temperature, and relative volumes follow exactly the same laws as relative weights.

For convenience in many calculations, Table 10 is given herewith, showing the pressure ratios, or $\frac{P}{P^o}$ for every pound from 1 to 110, and the volumes ratios will be inversely as the pressure ratiof and crnsequently the reciprocal of the figures on the table.

This might be called a table showing also the rates of isothermal compression or expansion, or Marriotte's law, the general formula for which is:

$P^o\ V^o = P\ V$ = constant; or in other words, the product of any pressure by its volume is always equal to the product of any other pressure by its volume, and this rule will be found useful in determining the contents of receivers, etc. It must always be remembered that in using these rules all temperatures must be alike, or corrections made according to the rules just given.

There are two methods of compressing any gas—

1. Where the temperature remains unchanged during compression. This is called isothermal compression and is the ideal method never realized in practice.

2. Adiabatic compression, which is the kind we meet in practice where the heat developed by compression expands, the air being compressed until it follows a different law from Marriotte.

While isothermal compression is not practical, it is necessary to know about it and how to make the calculations concerning it.

We have found that the volume ratios are inversely as the absolute pressure ratios in isothermal compression. Couseuuently, if the pressure ratios are 1, 2, 3 and 4, the corresponding volumes will be 1, ½, ⅓, ¼. To show this graphically, refer to Table 1, Fig. 1.

Let $A\ B$ be the line of 0 pressure, or the perfect vacuum line. $C\ D$ the intake line, and we erect pressures ordinates $G\ H = 2 \times D\ B$ at a point H equal to ½, $A\ B$ and and $L\ J = 3 \times B\ D$ at a point $J = \frac{1}{3}\ A\ B$ and $E\ K = 4 \times B\ D$ at a point $K = \frac{1}{4}$ of $A\ B$, counting all volumes from $F\ B$ or the end of the piston stroke.

If we join the points $C\ G\ I\ E$ in a curved line, it will be the isothermal or logarithmic curve and it will be noted that the area—

$$E\ F\ B\ K = 4 \times \tfrac{1}{4} = 1$$
$$I\ L\ B\ J = 3 \times \tfrac{1}{3} = 1$$
$$G\ M\ B\ H = 2 \times \tfrac{1}{2} = 1$$
$$C\ D\ B\ A = 1 \times 1 \text{ or } 1$$

As found before, $P^o\ V^o = P'\ V'$ = constant, and the figure represents the ideal indicator card for isothermal compression for four compressions, counting from 0, and the above method will always be proper to lay out an isothermal curve, no matter what the intake pressure may be.

To find the work of compression and delivery isothermally

$$P^o\ V^o \text{ hyp. log } \frac{P}{P^o} \text{ in foot-pounds in which}$$

P^o = Initial pressure absolute.
V^o = Initial volume.
P = Final pressure.
L = Work required.

In all of our calculations V^o will be taken as 1 cubic foot.

For example—How many foot-pounds of work is required to compress 1 cubic foot of gas at sea level to 80 pounds gauge pressure?

For sea level P^o per square foot = 14.7 × 144 = 2,116 8 pounds. Then

$$L = 2{,}116.8 \text{ hyp. log. } \frac{P}{P^o}$$

Consulting Table 10 we find $\frac{P}{P^o}$ for 80 pounds gauge = 6.442 the hyperbolic logarithm of which is 1.863.

Substituting, we have $L = 2{,}116.8 \times 1.863 = 3{,}943$ foot-pounds.

If a table of hyperbolic logarithms is not at hand, it would be well to remember that hyp. log. = common log. × 2.3026.

The horse power required for above work will be $\frac{3{,}945}{33{,}000} = .1195$ $H\ P$.

To find the $M\ E\ P$ of isothermal compression, $M\ E\ P = P^o$ hyp. log. $\frac{P}{P^o}$, using the quantities in the previous example we have $M\ E\ P =$ 14.7 × 1.863 = 27.38 pounds. We know that horse power = $\frac{M\ E\ P \times V}{33{,}000}$ and for 1 cubic foot $V = 1 \times 144$. Consequently, using the last example, $HP = \frac{27.38 \times 1 \times 144}{33{,}000} = .1195$, the same result as before. $\frac{1 \times 144}{33{,}000} = .00436$. Consequently a short and convenient formula would be for isothermal compression $H\ P = .00436 \times M\ E\ P$.

It will be noted that none of the physical properties of gases enter into the above equations, consequently we must conclude that it takes the same power to compress 1 cubic foot of any gas isothermally to the same pressure, provided the ratios of pressures are the same.

(To be Continued.)

The Great Photometrical Question: Fixed Light vs. Fixed Flow.—II.

By Mr. W. H. Y. Webber, in *Gas World*.

Let us now consider the London Argand Burner No. 1, adopted by the gas referees as the standard testing burner for common coal gas and stamped by H. M. Standards Department. Its construction is shown by the accompanying vertical section, which is half sized, in which *A* represents one of the three gas supply pipes to the burner body, *B* is the "gallery," *C* the cone, *D* the steatite burner body, and *E* the chimney, in this figure adapted to burn 14-candle gas. Although this burner is familiar to gas manufacturers and others, both by use and through the official notification of the referees, it is possible that its history and the arrangement of the parts upon which its action depends, may not be known to all those who will now look upon it with the interest attaching to a (by implication) discarded piece of apparatus, which has done good service in its time. As a matter of fact this particular burner was designed by Mr. William Sugg, at least 40 years ago, and was originally nothing more recondite than a certain number in a series of consumers' argand burners, in which it became favorably known as the "D" London Argand Burner. It was Mr. Sugg's peculiar claim to fame as a burner maker, that he was the first to standardize this manufacture. Before his time commercial burner manufacture was a rough and ready business; and all those who can remember the wretched things commonly called argand gas burners at that period—metal rings with tiny holes for the gas, which would not yield a regular shaped flame more than 1½ inch high—will admit the greatness of the improvement due to Mr. Sugg. It was not the least of Mr. Sugg's merits in this regard that he confined himself to doing what was possible with the most suitable materials and a simple design, such as the ordinary consumer could use. Others before him had made more or less "clever" burners, and so long ago as 1815 Mr. Clegg made a test burner with air deflecting cones, both outside and inside the flame circle; but apparently the referees did not regard the descendants of these testing appliances as consumers' burners, whereas the London Argands were actually in the market. These burners were accurately made with a steatite body, and were of different sizes according to the average gas consumption contemplated. The "A" and "B" sizes were found to be to small for general service, and were dropped out. "C" was a 22-hole burner and "D" was a 24-hole burner, the progressive increase of size for the higher numbers being 2 holes for each in the ring. For years the consumers' origin of the particular sized burner selected by the referees for testing common coal gas was indicated by the retention outside the chimney gallery, of spurs for carrying the usual opal glass saucer to diffuse the downward rays of light.

It is important to know that what came to be described as the London Argand Burner No. 1 was only the "D" burner of the original "London" series, made for 14-candle gas, and to be used with a 1¾-inch by 6-inch chimney. Thus it was prescribed by the referees for the Imperial and South Metropolitan Companies' 14-candle gas in 1876; which order was revised by the South Metropolitan Act of 1900. When the quality of the gas supply of London was raised to 16 candles (always at the 5 cubic feet rate of flow, be it remembered) the chimney of the same burner was enlarged to 2 inches by 6 inches. Another gallery was necessarily added, to accommodate this larger chimney. This order of adaption of the burner to burn 5 cubic feet of gas of different qualities appears to have been lost sight of. It is as a 16-candle gas test burner, with the 2-inch (outside measure) by 6-inch chimney, that the apparatus was stamped and standardized by the Standards Department; and, therefore, it was this adaptation, and not the burner as originally made, which came before and was accepted by the Departmental Committee of the Board of Trade last year as the only genuine article. Mr. Sugg himself objects to this substitution, declaring that it is a spoiling of the burner, to which he only added the larger gallery by direction of the referees, and to meet the exceptional condition of 14-candle gas provided for by the Acts—when the 5 cubic feet flame tails over the top of the smaller chimney.

At about the same period, the Gas Works Clauses Act, 1871, was passed, and in a schedule this act prescribed the photometer and other testing apparatus; but left the burner to be specified by the private Act. In some cases the burner was already prescribed, when it was usually the 15-hole Argand with a 7-inch chimney. Originally this burner had a brass body and no cones; but the Acts do not descend into these particulars, Consequently, any argand answering to the general description is a legal test burner; but in the large majority of cases, where it was left open, the London argand itself was chosen. In this way, to many people 14-candle gas came to mean a gas which, when burnt at the rate of 5 cubic feet per hour by the London Argand No. 1 burner with the smaller chimney, uncorrected for temperature and pressure, indicated the equivalent light of 14 candles by measurement in a Letheby or Evans photometer. Nobody seems to have noticed that this definition was hard upon the gas; nor perhaps was it at the period when the common coal carbonized in London and the south of England could be depended upon to yield from 14 to 15-candle gas by this measurement at the works, and it was not too costly to use a little cannel to make the gas up for 15 candles in order to be on the safe side.

The London Argand No. 1, moreover with the small chimney, gives concordant results at the 5 cubic feet rate for a pure coal gas, or gas lightly carburetted with cannel, averaging about 14 to 15-candle power by this method. When the gas contains benzol, native or added, it burns with a long yellow flame, by reason of the large proportion of air required for complete combustion. Thus such gas is always at its best in the London Argand Burner No. 1 when just on the verge of smoking, and the flame practically fills the small chimney. The best balance is difficult to obtain and keep; and trouble with the ventilation of the photometer not infrequently arises in these circumstances. Mr. Sugg improved the burner by inserting a solid peg in the central space of the body, which steadied the flame and made it possible to regulate its height to a certain measure. This is the burner of Sugg's Illuminating Power Meter, which when burning London 16-candle coal gas with a 3-inch flame, gives a light of exactly 16-candles at the 5 cubic feet rate. So long as the gas is made from coal or carburetted only with benzol, this burner will give strictly relative measurements of illuminating power, stated at the 5 cubic feet rate, but actually exhibiting a 3-inch flame with gas ranging from 11 to 50-candle power. It is always used, however, with a 7-inch by 1¾-inch chimney, and has a third air inlet. Hence it is called a tri-current burner.

The London Argand Burner No. 1 can be used in a variety of ways as a test burner for common coal gas of the quality for which it was originally designed; and gives correspondingly varying determinations. Mr. C. Hunt and others recommend that the larger chimney should be full of flame; which is also approved by Professor Lewes. Against this proposal it has been objected that there is some practical difficulty in carrying it out with a constant result, the gas sometimes showing a light of 18-candles, and sometimes 19 candles. This discrepancy may be due to atmospheric conditions, or to a difference in the gas itself; and it is impossible to say which is the true cause. The effect upon the calculated illuminating power for 5 cubic feet, corrected and reduced, may be ¼-candle; which is about the gain by burning a 14-candle gas in this way. Probably it would be practicable to burn any sample of reputed 14-candle gas, of any composition, in the London Argand Burner No. 1 to give a light of 18-candles. (The same description of gas containing an admixture of 20 per cent. of carburetted water gas would readily yield in the same burner a light of 20 candles from a 4-inch flame.)

The South Metropolitan and Commercial Gas Companies, as everybody knows, are content with a 16-candle power flame, with the London Argand Burner No. 1, which as already observed, gives a reading about ¼-candle higher than the 16-candle flame rate. As compared with the gas burned at the 5 cubic feet rate—that is to say, under the Gas Works Clauses Act, 1871—this 16 candle flame determination makes the gas anything from 2¾-candles to 1½ candle better than by the fixed 5 cubic feet rate. It is not possible to say what the amount of the difference will prove to be; but a guess which would probably be near the truth could be hazarded if the composition of the sample were known. Mr. W. J. Dibdin's table of tests, put in as evidence on the London Gas Bill, shows a maximum difference between the two methods of 2¾ candles during the month of April, with a minimum difference of 1.6 candles; and Dr. S. Rideal's tests gave 2.46 candles and 1.09 candles to correspond. My own independent tests, with both London and other gas of nominal 14-candle power, are in agreement with these determinations. I have found with a sample of pure coal gas made from Ravensworth Pelaw, level gauge on retort, make 10,060 cubic feet per ton, bar photometer, Harcourt's 10-candle standard, average illuminating power, determined from 16-candle flame, calculated to 5 cubic feet = 14.67 candles. Tested by the actual 5 cubic feet flame, illuminating power = 12 candles. This gas would just burn

with 18–19 candle flame in the larger chimney, thus showing ½ candle higher duty in the burner than the 16-candle flame; but of course, only in the still air of the photometer room. That is to say, it was hardly an ordinary consumer's experience.

(Concluded from Page 292.)

The Organization of Working Forces in Large Power Houses.[1]

By W. P. Hancock.

Storage Battery Division—Of the organization to operate storage batteries, I will say I believe that the cheapest man to have at the head is one who is both technical and practical in that line of work, and that he should be possessed of the same qualifications as are necessary in other heads of divisions with reference to handling men; but there is this to add, that it is seldom that men will work in the general line of storage battery repairs for any considerable length of time, in that such work is not of the sort that attracts the average man, and they do not stay long enough to actually show of what value they might be after a reasonable period of service.

Head of Department—I have refrained from speaking of the head of the generating system and the assistant to that person, for the reason that it seemed to me proper to look over what there was in the nature of organization and operation that the head and his assistant were called upon to look after. I now say that the head of the department has responsibilities as follows:

1st. The very important one of the organization of his department. If that be correct or as nearly so as conditions will permit, the operating responsibility, broadly speaking, will not seem as serious to the head of the department as it would under the more unfavorable condition of lax discipline in the handling of heads of divisions and men who have severally decided that the head of the depaatment is in his position for the sole purpose of bearing his title instead of directing the operation of the generating system. He should not only pass his orders on operation to his assistant, but in addition should see to it that they are carried out. He should carefully observe the result, and be ready to devise, if possible, methods of saving to his several accounts, as the total of these will represent his total generating cost. He should not, however, overdo the looking after of small details, for several reasons. First, because he has an assistant and several heads of divisions, who occupy positions and are paid salaries for the purpose of looking out for that portion of the business, and if they don't do it and relieve him in that direction, then either the organization or the discipline or both are not correct, and it is absolutely useless for him to expect to proceed on a successful basis until his own error, whether caused by neglect or otherwise, is corrected, and his people understand in a thorough manner that the head of the department is there to direct its operation.

The head of the department should also keep in touch with the intentions of his heads of divisions relative to their hiring of men, and not only confer with them in a general way on such matters, but lay down a rule that men connected in any way with matters detrimental to the interests of the corporation should not be hired in any event. He should include in such a rule a stipulation that if men of such type can get inside the organization notwithstanding proper precaution has been taken, they should be relieved from further connection with the department at once and be replaced by men of a different class.

I have found by some years of experience that to pay one line of work a standard wage, whether it be lower or higher than the so-called "union" scale, is productive of more contentment and better sentiment toward the employer than anything else I know of, but in order to do this consistently we must, as I have mentioned before, be careful to select a class of men who are very nearly alike with reference to the amount and quality of the work which they can perform. Such a thing can be done easily, as I know by actual experience.

It does not seem necessary to say that the head of the department should not absent himself from the system or from his office for any length of time without giving notice where he can be found in case of emergency, and the assistant and heads of divisions should be required to observe the same rule; for while such a rule may seem to be somewhat of a hardship at first, on second thought we can easily imagine cases where it would be most unfortunate not to be able to avail oneself of the services of one of the best men in his department just because one is unable to locate him; and besides, such a rule removes any chance of inference being drawn which might be detrimental to the man.

1. Abstract of paper read before the National Electric Light Association at its 28th Convention, held at Denver-Colorado Springs, Col., June 6-11, 1905.

The head of the department has at times to go farther than his office to get at the reason of the rise in some account which seems abnormal. He must, after exhausting other methods, simply get in and dig it out; get the reason, and see if it is a proper one, and if not, apply the remedy. If the reason is proper he is entitled to rest content, because he has assured himself that the rise in the account is not the result of reckless expenditure; if he finds a poor reason, he will strengthen his organization by taking the matter up with the proper party and going into it in a manner that cannot be misunderstood, and show where it is to the advantage of all concerned to make that expense nearer the proper amount.

It sometimes happen that difficulty occurs between some of the men and their superior, in which the man from the ranks feels that he has been misused; that his superior has been to hard on him because his advantage of position has given him the privilege. In such cases after the man has taken his trouble to the chief of his division and even then feels that he has a grievance, I believe it to be a good policy to allow him to see the head of the department as a last resort; for the head to call in all parties concerned at one time and hear the several stories, one at a time, and decide the matter. Of course, if the superior has used his position properly there can be but one result; if he has not, and you have to decide the man is not to blame, then be sure you have that man understand beyond a doubt that he cannot and must not mistake a just decision for a license to disobey in the future, but that he is bound to work for and obey the same superior, just as much as he was previous to the time when the difficulty ocurred.

It therefore seems that there are a good many places where the head of the department can put in his services and benefit the organization and if he can find the necessary time to walk out and through his system, even though he does not speak at all, no doubt he can see spots that will bear criticism, and it is for him to note them and, as I said before, "apply the remedy."

For the head of a department to say to himself, "We are now organized and operating satisfactorily, there is nothing more in that line at present," is a rash statement even to himself, as he will soon find out if he does not watch what he has tried to put together so carefully. To watch the organization, and constantly too, is what is in a large degree necessary to the attainment of a low cost per kilowatt-hour.

SPECIAL ENGLISH CORRESPONDENCE.

Communicated by Norton H. Humphrys.

Salisbury, England, August 10th, 1905.

Injurious Effects of Electric Light.—The Supply of Monazite Sand.—The Consumption of Gas and Novelties in Gas Lighting.

It is well known that since the introduction of electricity for lighting frequent complaints have arisen as to its injurious effect on the eyesight. Not long ago it was observed, in a large envelope directing establishment in London, that the substitution of electric for gas light led to a marked diminution in the amount of work done. Incandescent gas is generally preferred by letter sorters in the government employ, and in fact by all who have to do rapid reading or writtng under artificial light. In a recent number of the *Lancet* (a leading medical magazine) it was stated that the light of the incandescent electric lamp seems to be worrying, teasing the muscles of accommodation of the eye, and many people complain that reading by the electric lamp gives rise to headache. Possibly the fact that the light is rich in red rays, especially when the lamp is not burning with full efficiency, may have something to do with it, or perhaps the distribution of the light from a loop instead of a fixed center may have some disturbing effect upon the eye. At a recent congress af the Royal Institute of Public Health a medical authority gave it as his opinion that since the introduction of electric light the eyesight both of school children and of adults was suffering. He had noticed as much with regard to his own eyesight, and thought it would be a desirable matter to investigate whether certain rays given out by the electric light might not act detrimentally on the optic nerves. The probable explanation of this matter is to be found in the very small area occupied by the source of the light. The arc light is very little more than a point, and one glow light is a mere curved line. The result is that to produce a given photometrical result, say 100 candles, the intensity of the light must be very much greater than that of an incandescent gas burner, which represents an area of 3 or 4 square inches. Many people prefer to reduce the intensity of an ordinary gas light even at the loss of illuminating power. They say that they can see better with an opal globe that, according to the photometer, cuts off 50 per

cent. of the light, as they find it more comfortable for the eyes A 16-candle (nominal) glow lamp, however, will not stand much in the way of frosted or opal shades, and, therefore, is usually used naked. If shaded, it does not give light enough, and a shaded 32 or 50-candle electric light is a costly luxury. There is also something in the objection to the color of the light. From the first this objection was sought to be covered by means of tinted globes or shades. When the incandescent gas light was introduced the same plan was followed. But for all practical purposes tinted globes have been discarded. They are never to be seen in shops or offices. If shaded at all. opal is used. And even in drawing rooms, the red or yellow tinted glasses that at first were generally preferred are gradually disappearing. Gas companies find that there is absolutely no demand for colored glass. The incandescent gas light is the nearest approach to daylight and is, therefore, preferable, and does not try the eyesight like a light having a decided tint, either of red, orange or blue. And this fact has much to do with the popularity of the incandescent gas light, apart from its comparative cheapness.

It is surprising, looking at the extent to which gas undertakings are dependent upon the mantle, that only one gas company has interested itself in the question of the supply of thorium. That is the South Metropolitan Gas Company, and the Directors have a paragraph on the subject in their report to the shareholders for the past half year. They do not exaggerate the position when they state that a supply of reliable incandescent mantles at a reasonable price is a vital necessity to the gas industry. If the supply was restricted, or the price materially increased, the position of gas would be seriously jeopardized; and the supply of thorium is dependent upon the supply of monazite sand, a substance which is practically under the control of two concessionaries in Brazil, who are known as the Thorium Convention. As a result, the price of thorium nitrate has advanced from 15s. to 23s. per pound within the last two years, and a further advance is said to be imminent. In 1903 the Company sent an agent to Brazil to negotiate a purchase of monazite, but without result; but they have since been more successful with regard to a deposit of monazite in the United States. Plant for working has been erected and a supply of monazite from the new source will be shortly delivered in England, and the Directors are able to state that their anxiety as to the supply of monazite sand is entirely relieved. If this action of the Company has the effect of breaking a corner in thorium, they will deserve the thanks of the whole industry, as they do in respect to many other matters. In February last I alluded to an important find of the incandescent metal in Ceylon, so it is evident that the Brazil suppliers do not hold all the cards. Judging by the activity in the mantle trade, thorium is plentiful, as almost every post brings a circular from some new firm who claim to be able to supply cheaper, more efficient or stronger mantles than anybody else. Unfortunately, although there has been a great deal of talk about stronger mantles, all that are at present on the market possess but little if any new cohesive properties than those supplied 7 years ago. Many engineers go farther than that and say that the older mantles were the better. A great requirement at the present time is not so much a cheaper as a really stronger mantle, and one in which the equivalent in strength extends to the bulk of the goods, instead of being confined to the samples carried by the selling agent.

From the reports of gas undertakings for the past 6 months, which are now being issued to the shareholders, it would appear that the increase in consumption that has been a feature for the last year or two has not been maintained. Various explanations of this result are offered, and on reading them one is forced to the conclusion that it is absurd to pretend to account for every fraction per cent. decrease or increase in the quantity of gas consumed. It is a result made up of many factors, some for and some against, and some that are apparent on the surface, while others are not unearthed without considerable trouble and delving. As it is, the matter is explained more according to the speaker's predilections than upon the results of actual investigation. An electriaal enthusiast, of course, falls back upon the competition of the light of the future, while the gas engineer as naturally looks to the difference in consumption between a Welsbach light and the 2 or 3 flat flames that it has probably displaced. Climatic influences account for a great deal, and the mild weather experienced during February and March, 1905, as compared with that during the same period in previous years, is sufficient to account for 2 per cent, or so. There has not been any special happenings to account for or bring about a lessened gas consumption within the last 12 months. It is simply a case of a somewhat thin year following two or three fat ones. Anyway, the general experience is in the direction of only a 1 to 2 per cent. increase, instead of the 4 or 5 to which we have become so accustomed as to look for it as a regular thing. Some of the explanations offered are more amusing than edifying. The Chairman of the Ascot District Gas Company blames the motor car, which already has quite enough to answer for. At the time of the Ascot races, he says, furnished houses in the district do not let as they used to do, because people living at a distance can get to the races on motor cars. A small provincial company announce that owing to the great reduction in the quantity of gas consumed on account of the general introduction of the incandescent burner, they are reluctantly compelled to advance the price 6d. per 1,000 cubic feet. The wisdom of this policy is not very obvious, and it would appear that the consumers are considerably in advance of the directors. To be consistent, any consumer who is willing to retain his old business should be also allowed to retain the old price, which, it is scarcely necessary to add, is already high. The idea seems to be that because the consumers have reduced their bills 10 per cent., they will be prepared to accept an increased price in a corresponding proportion, and it will be interesting to know how far this anticipation is realized. Probably a little patience would see the matter adjust itself by increases in the number of burners. Many who at present have lights in one or two rooms only would be tempted to extend by efficiency and cheapness; but a more efficient means of checking any tendency of this sort than a substantial rise in the price of gas could scarcely be devised.

An annual ironmongery, hardware, electrical and allied trades exhibition has been held in London, and is noticeable for the fact that, while electricity was scarcely to be seen, gas, although left out in the title, was well represented amongst the exhibits. As that is the feature that will influence the visitors, rather than the title that appears at the head of the catalogue, no prejudice to gas will result, though at the same time it is remarkable that, while over a dozen specialists in gas lighting hold stalls in the show, a bid should not have been made for the attendance of gas consumers. Nearly all the exhibitors favor the incandescent system, and many of them the inverted light, or a light at any angle. Coming just at the beginning of the lighting season, the exhibition of several important novelties cannot but have a beneficial effect. In other directions there is ample evidence that a large number of manufacturing firms intend to run a leading line in gas lighting. A good start was made with the inverted burner last winter, and although at first sight there appears something whimsical in turning a burner upside down, it is evident by the improvements now being put upon the market that there are many advantages in the idea, and that it is likely to be largely adopted. For one thing, it means shorter and more concentrated flame and a shorter and stronger mantle. From last winter's experiences I can say that gas undertakings who run a maintenance department will do well to direct their attention towards the inverted burner, as the durability of the mantles is decidedly greater than with the upright. The names of some of the firms exhibiting are already household words at the gas works, while others are newcomers.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

A STATUE is to be erected in Paris in honor of Philippe Lebon, who took out a patent in 1801 on the use of gas for lighting purposes.

FOLLOWING the reported purchase of a large interest in the Bristol (Tenn) Gas and Electric Company, many changes will be made in the present electric and gas systems.

THE Key City Gas Company, of Dubuque, Ia., is erecting a gas tank 84 feet in diameter and 24 feet in depth, and will be built entirely of concrete.

A SYNDICATE of Detroit capitalists, headed by Emanuel T. Beyer, purchased the Union Gas Light and Electric Company, of Bloomington, Ills., for $400,000, the amount of the capital stock.

ARMOURDALE, a suburb of Kansas City, Mo., is now supplied with natural gas.

MR. PIERRE PLANTINGA, President of the Gas Machinery Company, has returned after a 4 months trip' through Europe, where he had a good rest and later an enjoyable visit among the largest gas plants.

PLANS are being prepared by the North American Company, owner of the Laclede Gas Light, United Railways and Union Electric Light and Power Companies, for a mammoth gas works and general fuel supply yards on a large tract of land along both sides of the River des Peres, east of Broadway, in Carondolet, Mo.

GRAHAM WITSCHIEF and Benjamin J. Macdonald, Receivers of the Goshen (N. Y.) Gas and Fuel Company, will sell all the property and assets of the Company at a public auction on Tuesday, September 5, at the Company's works on West Main street, Goshen. The land held by the Company, together with the buildings and improvements upon it, the gasholders, oil tanks, street mains and all the corporate rights and franchises will be sold in bulk subject to a mortgage of $30,000 now a lien thereon.

THE Edison Electric Company, of Los Angeles, Cal., has acquired the Riverside Light and Fuel Company, the Pomona and Ontario Light and Fuel Company, and the Whittier Light and Fuel Company, all suburban companies.

MR. L. C. HAMLINK has incorporated the St. Louis Gas Construction Company, at St. Louis, Mo., making a specialty of benches and firebrick for water gas apparatus. Mr. Hamlink is well known in connection with this class of work.

MR. F. S. HASTINGS, President of the Indianapolis (Ind.) Gas Company, when asked about the proposed franchise for 60-cent gas in Indianapolis, said that no effort had been made to oppose this ordinance because the gas which it is proposed to sell at 60 cents has only 14-candle power and its caloric value for heating and cooking is far below the standard of the 18-candle power gas which the Indianapolis Gas Company are now selling for 90 cents; and that while it is quite possible that the common council may ratify this franchise, it is very doubtful whether sufficient capital can be secured, in view of the fact that the ordinance proposed calls for the immediate expenditure of $1,000,000 and exacts obligations to spend at least an additional million dollars for extensions. Mr. Hastings stated further that he doubted very much whether the people of Indianapolis would consent to having 100 to 250 miles of streets torn up, in view of the fact that the citizens would derive no benefit from the distribution and sale of an inferior quality of gas at 60 cents, the use of which would not effect any saving to the consumer; and that the movement was started by a certain newspaper, actuated by political motives.

JUDGE SWARTZ, at Norristown, Pa., has granted an injunction to restrain the North Penn Gas Company from laying pipes in Lansdale.

PLANS for a tunnel under the Milwaukee river near the foot of Jefferson street have been drawn by the Engineer of the Milwaukee Gas Light Company and forwarded to the government's engineering office at Washington. The tunnel will be large enough to carry all of the Company's mains.

THE Adrian (Mich.) Gas Company is now actively engaged in the construction of a new plant. The new building and apparatus will be constructed entirely of steel and will be put up by the Lloyd Construction Company. The Laclede Firebrick Company will put in the retort work. It will take about two years to complete the entire work of removal, but sufficient will be done this fall to supply the present gas output from the new plant and thus abandon the old one that has stood on its present site since June, 1855, a full half century. The present large gasholder will remain where it is, as will also the water gas outfit.

AGAIN the Cincinnati Gas Company is threatened with opposition with natural gas. J. M. Garard, General Superintendent of the Ohio Fuel Company, a natural gas concern, says that soon after September 5, when a meeting of the stockholders will be held, the laying of pipes from the Licking field to Cincinnati will be pushed. At the meeting the discussion will be on increasing the capital stock from $4,000,000 to $8,000,000. The main pipe will be 18 inches and will be lined through London, Springfield, Dayton and other cities to Cincinnati. The first allotment of the increased capital stock, which will be 25 per cent, is to be issued October 20.

GENERAL MANAGER LATHROP, of the Detroit (Mich.) Gas Company, informed the Council Committee that the Company would give a sliding scale around 60 or 70 cents if the city amends the franchise so as to make such a thing legal. This price is to be allowed large consumers for fuel purposes.

THE New York State Gas Commission held its first meeting at the Ten Eyck, Albany, August 7th, and installed F. E. Gunnison, of New York city, as Chairman, he having been designated under the law to act as such by Governor Higgins. The other members of the Commission are John C. Davies, of Camden, Oneida county, former Attorney-General, and L. L. Sheddon, of Plattsburg, Clinton county, formerly County Judge, and a political ally of Secretary of State John J. O'Brien. The Commission has secured the Ways and Means Committee room on the third floor of the Capitol for temporary use, and will hold its meetings there until permanent quarters have been secured. The Commission is required by law to meet at least once a month in Albany and to maintain offices there. An office may be established in New York and another in Buffalo, if the Commission deems it necessary. Chairman Gunnison says that an office would undoubtedly be opened in New York city, but the Commission would determine later if it is necessary to have a third office in Buffalo.

GENEVA, N. Y., seems satisfied with its gas supply as evidenced from the following clipping taken from the Seneca *Gazette;* this is good advertising for any town. "The Seneca Falls people are still hollering for cheap gas. We do not recall the price down there. In Geneva the price to consumers is $1.50 per 1,000 cubic feet. The original company charged $5, and we regarded it as a God-send when the price was cut just one-half, and afterwards a dollar more cut off. At first it was used as a luxury, and an ordinary man could not afford gas. Oil and tallow candles were used. In the early 60's we had to shut off the meter in the printing office and to return to oil with all its troubles, for gas bills ran up to $12 a month. At $1.50 people use it largely for cooking and there are probably 500 gas ranges for cooking in use here, cheaper than coal at $6 a ton. Very soon gas steam heating boilers will be invented, and that will end the big coal bills and screening of ashes, and perhaps give us a further reduction in the price of gas. If Seneca Falls pays no more than Geneva pays, we don't see where the occasion for hollering comes in. Our streets are underlined with gas pipes too, and the company has the franchise and all that sort of thing. Of course, if they can get better gas and cheaper by municipal ownership, that's all right"—Can they?

OWEN MCGRATH, an employee of the Springfield (Mass.) Gas Light Company, was imprisoned in a burning tar reservoir for nearly half an hour. When he had been given up for dead he emerged from the boiler room covered from head to foot with soot, and though scarcely recognizable, was uninjured. In some unexplained manner the tar reservoir which feeds one of the large boilers caught fire. Roland W. Stebbins, who is in charge of the manufacturing department, rang in an alarm from the Company's private box. The flames spread so rapidly that McGrath's escape was cut off. The firemen soon had several streams of water directed against the flames, and several times Chief Littlefield and half a dozen men essayed to rescue McGrath, but were driven back by the smoke and flames. McGrath's wife arrived on the scene and was informed that her husband was probably dead. Meantime McGrath was making a valiant struggle for existence. When he found he was hemmed in by the fire he put his head through an aperture in a dividing wall and, though nearly overcome by smoke, managed to retain consciousness. He heard the shouts of the firemen and knew that a determined effort was being made to reach him. When the commotion ceased, McGrath realized that he had been given up for lost. The flames became hotter and McGrath decided upon a desperate break for life. He breasted the flames, leaped through a wall of fire, and a minute later dashed into the crowd of spectators, dazed almost to the point of unconsciousness. A mighty cheer ascended when he appeared. The reservoir and boiler room are constructed entirely of brick and steel and the fire loss will be small.

THE contract for the construction of the gas plant at Sterling, Ills., has been let to Frank D. Moses for $50,000. Work will be commenced September 15. Mr. Thomas Crawford, Superintendent of the Sterling Company, goes to the Clinton (Ia.) Gas Light Company as its Superintendent.

THE Hartford (Conn.) Gas Light Company will supply East Hartford with gas, having obtained the franchise for so doing.

MR. JOHN C. OWENS has been appointed Superintendent of the Elgin (Ills.) works of the Western United Gas and Electric Company.

IT is announced that the Boston Consolidated Gas Company proposes to expend between $200,000 and $250,000 in remodeling the purifying plant at Everett.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

CHAS. E. SANDERSON,
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NOTIFICATION RESPECTING ADVERTISING.

Orders for new advertising, or for changes in standing advertisements, to insure attention in the issue following their reception, must be in hand any time of Wednesday.

MONDAY, AUGUST 28, 1905.

The Market for Gas Securities.

There has been a broad and active stock market for the past week. Quotations were generally higher, and the volume of business was good and well distributed. Consolidated gas, of New York, shows very little change from last week's prices, with very small amounts of stock changing hands. Gas bonds still continue in good demand, with light offerings.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

AUGUST 28.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	186	187
Central Union, Bonds, 5's.	3,000,000	1,000	108½	110
Equitable Bonds, 6's	1,000,000	1,000	..	103
" 1st Con. 5's	2,300,000	1 000	118	120
Mutual	3,500,000	100	300	320
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co.. Bonds, 5's	11,000,000	1,000		113
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	35	.
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	..	..	..
Northern Union, Bonds, 5's.	1,250,000	1,000	104	106
New York and East River.. Bonds 1st 5's	3,500,000	1,000	112	114
" 1st Con. 5's	1,500,000	..	106½	108½
Standard	5,000,000	100	125	130
Preferred	5,000,000	100	145	155
Bonds, 1st Mortgage, 5's	1,500,000	1,000	116	117
Yonkers	299.650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	185	190
" " Bonds(5's)	15 000,000	1,000	113	115
Bay State	50,000,000	50	⅛	3/16
" ncome Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	..	65
" 1st Mtg.5's	509,000	1,000	93	96
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	6	7
" " Bonds, 5's	5,250,000	1,000	66	68½
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas and Electric Co	29,500,000	100	106⅝	106⅞
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	97½	99
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	..	95
Preferred	3,026,500	100	107½	103
Consumers, Toronto	,000,000	50	200	204
Consolidated, Baltimore	11,000,000	100	86	89
Mortgage, 6's	3,500,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N. J.	1,000,000	100	15	17
" Con. Mtg. 5's	880,000	1,000	89½	92
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50	..	50
" Prior Lien 5's	5,603,000	1,000	..	98
Detroit Gas Co., 5's	281,000	1,000	75	80
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
For Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	85	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	..	104½	105½
" Bonds, 5's	10,500,000	..	107	108
Indianapolis	2,000,000	..	70	75
" Bonds, 5's	2,650,000	..	104½	105
Jackson Gas Co	250,000	50	82	..
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	..	.
Preferred	2,500,000	100	95	100
Bonds	10,000,000	1,000	108½	109
Lafayette Gas Co., Ind	1,000,000	100	..	60
Bonds	1,000,004	1,000	60	65
Louisville	2,570,000	50	143	145
Madison Gas & Elec. Co. " 1st Mtg. 6's	350,000	1,000	107½	108½
" 6 per cent. scrip, due 1910	100,000	25	85	87
Montreal, Canada	2,000,000	100	218	218½
Nashville Gas Lt. Co	1,000,000	100	110	..
Newark, N. J., Con. Gas Co.	6,000,000	..	58	58
Bonds, 6's	4,600,000	..	105	105½
New Haven	2,000,000	25	200	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	105	105½
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	.
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal	15,800,000	100	58½	58⅝
St. Joseph Gas Co. " 1st Mtg. 5's	751,000	1,000	94	96
St. Paul Gas Light Co	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	113½	115
General Mortgage, 5's	2,465,000	1,000	92	93
Syracuse, N. Y.	1,975,000	100	50	55
Bonds	2,047 000	1,000	102	..
Washington, D. C	2,000,000	20	317	320
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	..	..	..
Wilmington, Del	600.000	50	230	..

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(*Continued on page 336.*)

SEALED PROPOSALS.

OFFICE CITY OF GUELPH LIGHT AND POWER DEPT., GUELPH, ONTARIO, July 31st, 1905.

Sealed proposals will be received at above office until 12, noon, on Sept. 1, for the erection of three buildings and apparatus consisting of retorts, exhausters, condensers, scrubbers, governor, holder, water gas apparatus, etc. Plans and specifications may be seen at office as above and at the office of James Gardner, Jr., Co., 202 Lewis Block, Pittsburgh, Pa.

Time for receiving tenders has been extended to noon, Sept. 1.

1577-1 JOHN YULE, Mgr.

NOTICE!

PLEASE read the advertisement of the Empire Gas Improvement and Construction Company, on page 341 This Company employs only high-priced and quick-working mechanics, and all its work is guaranteed to be strictly first class, and will be finished at time specified. A. M. SUTHERLAND,

1545-eot. tf 49 Wall Street.

POSITION WANTED.

Sixteen years' experience in the operation and management of gas plants. Can show good record. Experienced in coal and water gas, electric and water works. Age, 39.

1577-2 Address, "C. W. G.," care this Journal.

POSITION WANTED.

An All-Around Gasfitter and Meter Repairer

Desires a position with or to take charge of a small plant Fifteen years' experience in New York—references.

Address, "T. J. F.,"

1577-1 Care this Journal.

Position Wanted

By a young man who has had 15 years' experience in the lighting business. Have held present position as superintendent of combined gas and electric plant for 8 years,

1577-3 Address, "H. M. E.," care this Journal.

Position Wanted

As Manager of a Gas Company,

By a young man having 15 years' experience in the manufacture and distribution of coal and water gas. Thoroughly conversant with office work. Good references can be given. Address, "M. J.,"

1576-2 Care this Journal.

Position Wanted.

Energetic young man, technical engineer, seven years' experience in small and large plants in the manufacture and distribution of coal and water gas and in construction work, is open for a position. Am also experienced in uniform system of accounts. References from present and past employers. Address, "A.,"

1577-2 Care this Journal.

WANTED,

ENGAGEMENT by an engineer having 11 years' experience in the construction and operation of coal and water gas plants.

Address, "O. A. B.,"

1577-2 Care this Journal.

WANTED,

A Works' Foreman.

One capable of operating full-depth regenerative benches and Lowe water gas apparatus. Applicants must give a complete analysis of their experience and name references. Address, "S. H.,"

1575-3 Care this Journal.

WANTED,

A Manager for a Gas Company

Having annual sales of about 10,000,000 cubic feet (coal gas), located near New York. Address, "BAXTER,"

1577-2 Care this Journal.

WANTED,

A SECOND-HAND 8, 10, 12 OR 15 ACTUAL HORSE POWER OTTO GAS ENGINE.

Address, . . . "C. G. P.,"

1576-tf Care this Journal.

WANTED,

ONE CAR CONCENTRATED GAS LIQUOR.

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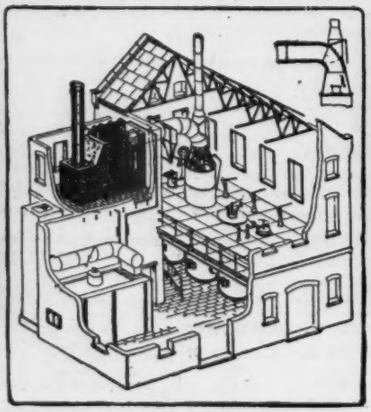

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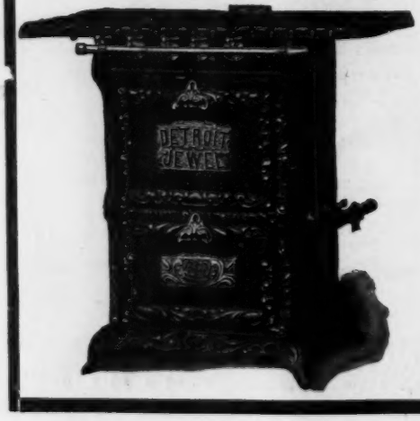

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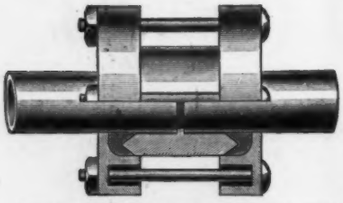

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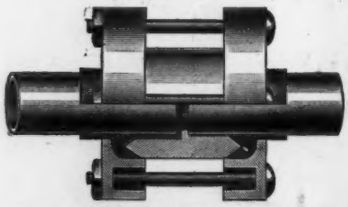

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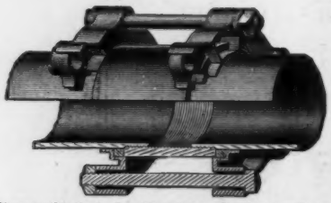

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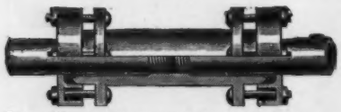

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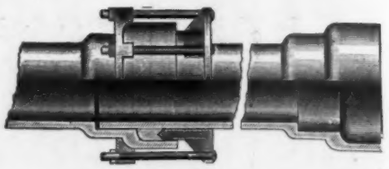
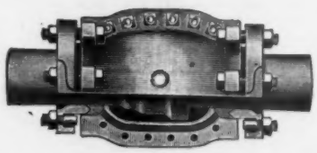


Coupling, Style 9, for Special Style Cast Iron Pipe.



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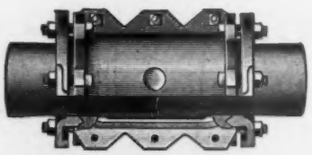

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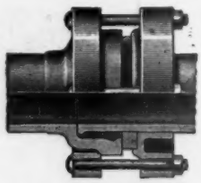

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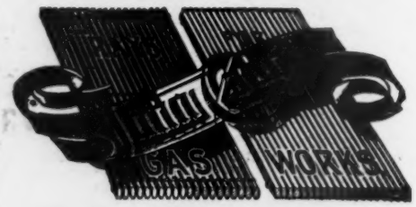

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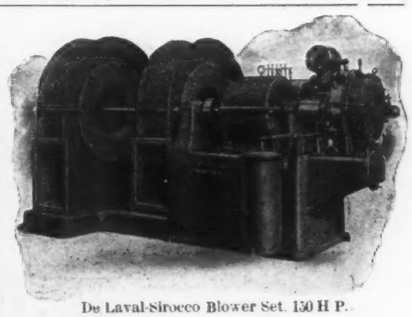

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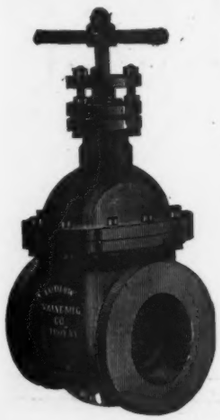

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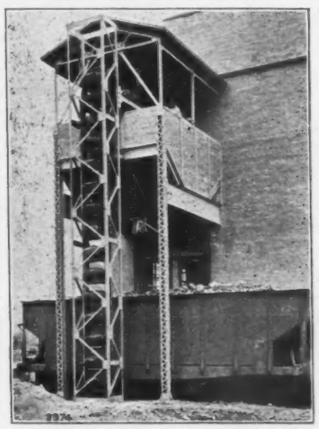

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EMPIRE GAS IMPROVEMENT AND CONSTRUCTION CO.

This Company has purchased the patents and goodwill in the business hitherto carried on and owned by *A. M. Sutherland.* It is now ready to contract for the erection and installation of

ENTIRE GAS WORKS,

or any separate portion of the same, such as **Gasholders, Coal Gas Benches, Lowe-Sutherland** double-superheater **Water Gas Sets,** Scrubbers, Condensers, Exhausters, Purifying Boxes, Street Governors, Street Mains and Main Laying.

The high character of the work done by A. M. Sutherland during the past 15 years will be strictly adhered to and all work is warranted.

Mr. Sutherland remains with the Company for two years President and Director, and will give personal attention to contracts.

EMPIRE GAS IMPROVEMENT AND CONSTRUCTION CO., 49 Wall St., New York.

IMMERSION WASHERS.

A design embodying particularly desirable features.

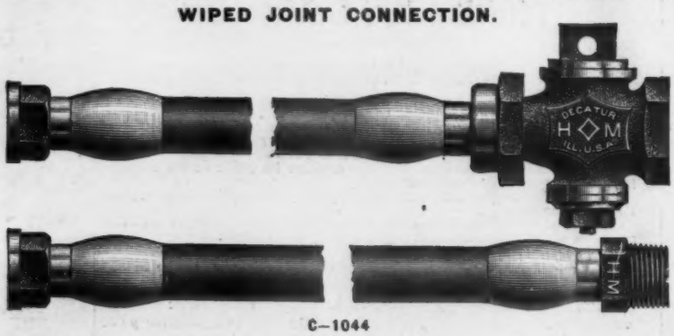
LLOYD CONSTRUCTION COMPANY,

Western Sales Agents for
BARTLETT, HAYWARD & CO., Baltimore, Md.

DETROIT, MICH.

MUELLER GAS METER CONNECTIONS.

WIPED JOINT CONNECTION.



C—1044

Uniformity in length and shape of wiped joints in a set of meter connections is not always obtainable when the gas man makes his own, because his work is done at odd times by hand, and his men haven't enough practice to make them skilled.

Mueller Wiped Joint Meter Connections are made with the aid of automatic machines that cut and shape any number of pieces of pipe exactly alike, and the continual daily practice afforded the workmen make them highly skilled in the various operations. The joints are always uniform in length and shape.

Mueller Wiped Joint Meter Connections are made with regular full length fittings and the pipe slightly swedged to accommodate them. They are made in 270 sizes and specifications. The connections illustrated have straight meter couplings on one end and male soldering nipple and union meter cock on the other.

Each set of connections is carefully inspected and assembled, is given a 75-pound hydraulic pressure test, bears the Mueller trade mark, and is *unconditionally guaranteed.*

We also make tapping machines and ground key cocks for gas works' use. Catalogues upon application.

HIGH PRESSURE GAS GOODS.

We make high pressure gas tapping machines for drilling holes of all sizes, from ⅛ to ½ inch under the highest pressure; all sizes of separate service clamps and tees, and combined clamps and tees for high pressure work; high pressure gas cocks of special design with solid plugs in which holes are drilled of any size desired.

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H. MUELLER MFG. CO.

Eastern Division
NEW YORK, N. Y., U. S. A.
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ROOTS' GAS EXHAUSTERS.

GOLD MEDAL AT ST. LOUIS, 1904.

Installation showing our latest improved machines, with flexible rope coupling, for large units.

SEND FOR CATALOGUE.

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For several years associated with the late
CAPTAIN WILLIAM HENRY WHITE,
WILL CONTINUE THE BUSINESS OF

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For Gas, Water and Electric Light Companies, at
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TELEPHONE, 5534 BROAD.

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Estimates Furnished on any kind of Work in Connection with Gas or Water Plants.
SPECIAL ATTENTION GIVEN TO THE REMODELLING AND EXTENDING OF THE PROPERTIES OF WORKS NOT UP-TO-DATE.
CORRESPONDENCE SOLICITED.

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EMAUS PIPE FOUNDRY.

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MANUFACTURERS OF

CAST IRON PIPE AND SPECIAL CASTINGS

FOR WATER AND GAS.

Also, FLANGE PIPE, LAMP POSTS, Etc.

GAS TAPPING MACHINES

—FOR—

Drilling and Tapping Pipe under Pressure

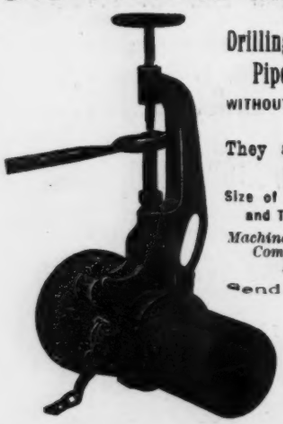
WITHOUT ANY ESCAPE OF GAS.

They are Strong and Compact.

Size of Combination Drills and Taps ¾ to 4-inch.

Machines Sent to any Gas Company for Thirty Days' Trial.

Send for Circulars.



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DAYTON, O.

MUELLER GAS MAIN TAPPING MACHINE.

C—1004.

The Mueller "Swivel No. 1," "Swivel No. 2" and "Swivel No. 3" Tapping Machines are made especially for tapping gas mains under pressure. They are made extra heavy in all parts, have extra long ratchet sweep and can be adjusted to any angle or corner of the ditch. The No. 1 taps up to 2-inch, the No. 2 up to 3-inch and the No. 3 up to 4-inch. The "Century Junior" makes taps from ⅛ to ⅛ inch in high pressure mains. Unconditionally guaranteed. Catalogues upon application.

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Globe Street and Boulevard Lamps.
Cheapest and Best
THOUSANDS IN USE WITH INCANDESCENT BURNERS.
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Plans prepared and Estimates furnished at short notice.

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Established 1856. Works at Phillipsburgh, N. J.

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CAST IRON WATER AND GAS PIPE,

FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF

Flange Pipe for Sugar House and Mine Work. Branches, Bends, Retorts, etc., etc.

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Flanged Pipe and Fittings, Hydrants, Gates, Pig Lead, etc. etc.

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Manufacturers of Lead Pipe, Solder, etc., and Jobbers of Plumbers' and Tinners' Goods.

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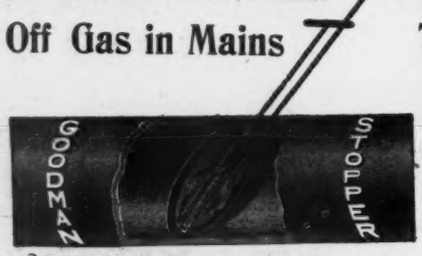
Wholesale Eastern Agents AKRON VITRIFIED SEWER PIPE.

SAFETY GAS MAIN STOPPER COMPANY,

For Shutting Off Gas in Mains

Any size gas main can be shut off in 30 seconds. : : :



Temporarily during alterations and repairs. : : : :

STOPPERS SENT ON TRIAL.

Address: SAFETY GAS MAIN STOPPER CO., 1668 Park Ave., New York City.

This is No. 2.

Height, 36 inches.
Diameter, 12 "
Shipping weight, 80 lbs.
Net weight, 50 lbs.
The products of combustion are entirely separate from the water. Entire water surfaces are tinned.

Price, $35.00.

HOT WATER

FOR BATHROOM AND KITCHEN

is most easily, quickly and economically supplied by a

Humphrey Crescent Instantaneous Water Heater.

Prices range from $20 to $45.
Every Heater GUARANTEED.

Set a heater for every gas consumer. You will please them and increase sale of gas at the same time.

Send to-day for catalogue and discounts to

HUMPHREY CO.,
Kalamazoo, Mich.,

The only manufacturers in the World of a COMPLETE LINE OF INSTANTANEOUS WATER HEATERS.

GEORGE R. ROWLAND,
Formerly with the Continental Iron Works.
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Drawings, Specifications and Estimates furnished for the construction of new works or alteration of old works. Special attention given to Patent Office drawings.
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AMERICAN METER CO.,

NEW YORK, ST. LOUIS, PHILADELPHIA, SAN FRANCISCO, CHICAGO,

Photometrical and Experimental Apparatus.

PUBLIC LIGHTING TABLE.

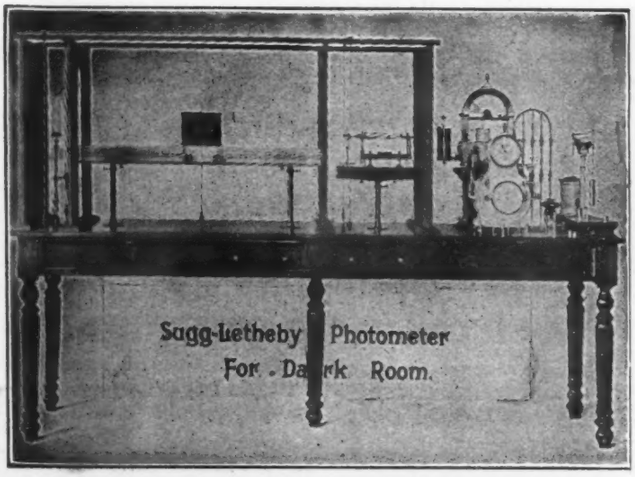
SEPTEMBER, 1905.

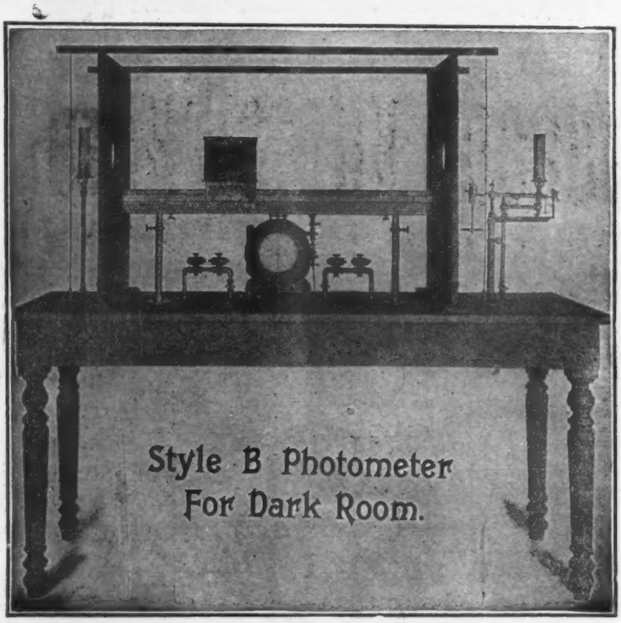
Day of Week.	Table No. 1. FOLLOWING THE MOON. Date.	Light.	Extinguish.
Fri.	1	7.10 PM	4.20 AM
Sat.	2	7.10	4.20
Sun.	3	7.00	4.30
Mon.	4	9.00	4.30
Tue.	5	9.50 FQ	4.30
Wed.	6	10.40	4.30
Thu.	7	11 30	4.30
Fri.	8	12.30 AM	4.30
Sat.	9	1.20	4.30
Sun	10	2.20	4.40
Mon.	11	3.20	4.40
Tue.	12	No L.	No L.
Wed.	13	No L. FM	No L.
Thu.	14	No L.	No L.
Fri.	15	6.40 PM	8.20 PM
Sat.	16	6.40	8.50
Sun.	17	6.30	9.20
Mon.	18	6.30	9.50
Tue.	19	6.30	10.30
Wed.	20	6.30	11.10
Thu.	21	6.30 LQ	12.00
Fri.	22	6.30	12.50 AM
Sat.	23	6.30	1.50
Sun.	24	6.20	2.50
Mon.	25	6.20	4.50
Tue.	26	6.20	4.50
Wed.	27	6.20	4.50
Thu.	28	6.20 NM	4.50
Fri.	29	6.20	4.50
Sat.	30	6.20	4.50

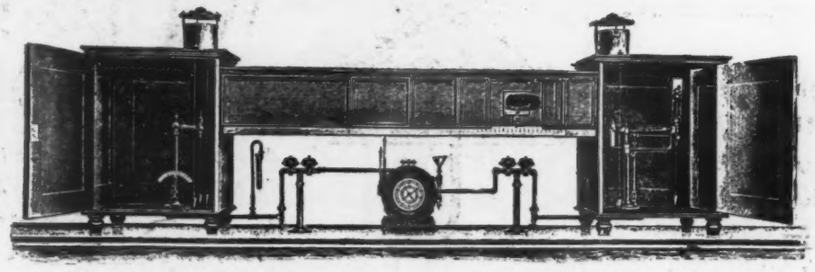
TOTAL HOURS DURING 1905.

By Table No. 1.

	Hrs.Min.
January	240.50
February	192.20
March	207.00
April	175.10
May	161.00
June	139.50
July	149.00
August	161.50
September	173.00
October	205.00
November	211.00
December	229.00
Total, yr.	2245.00







Closed Photometer For Light Room.

CIRCULARS SENT ON REQUEST.

PUBLIC LIGHTING TABLE.

SEPTEMBER, 1905.

Day of Week.	Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING. Date.	Light.	Extinguish.
		P. M.	A.M.
Fri.	1	6.30	4.20
Sat.	2	6.30	4.20
Sun.	3	6.15	4.30
Mon.	4	6.15	4.30
Tue.	5	6.15	4.30
Wed.	6	6.15	4.30
Thu.	7	6.15	4.30
Fri.	8	6.15	4.30
Sat.	9	6.15	4.30
Sun.	10	6.05	4.40
Mon.	11	6.05	4.40
Tue.	12	6.05	4.40
Wed.	13	6.05	4.40
Thu.	14	6.05	4.40
Fri.	15	6.05	4.40
Sat.	16	6.05	4.40
Sun.	17	5.55	4.50
Mon.	18	5.55	4.50
Tue.	19	5.55	4:50
Wed.	20	5.55	4.50
Thu.	21	5.55	4.50
Fri.	22	5.55	4.50
Sat.	23	5.55	4.50
Sun.	24	5.40	5.00
Mon.	25	5.40	5.00
Tue.	26	5.40	5.00
Wed.	27	5.40	5.00
Thu.	28	5.40	5.00
Fri.	29	5.40	5.00
Sat.	30	5.40	5.00

TOTAL HOURS DURING 1905.

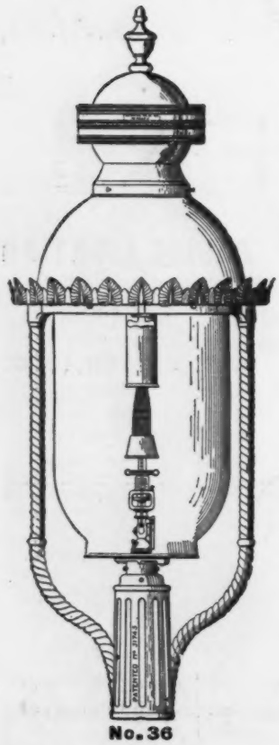
By Table No. 2.

	Hrs.Min.
January	423.20
February	355.25
March	355.35
April	298.50
May	264.50
June	234.25
July	243.45
August	280.25
September	321.15
October	374.30
November	401.40
December	433.45
Total, yr.	3987.45

NEW YORK, 97 Liberty Street. BOSTON, 814 Beacon Building. PHILADELPHIA, Broad and Arch Streets. ST. LOUIS, 712 Roe Building. CHICAGO, Foot of Orleans Street. SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



No. 36

Controls and Operates the

Welsbach System of Street Lighting,

Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others interested in Municipal and Outside Lighting.

No. 38.

The Welsbach No. 6 Harp Fixture.

AN IDEAL LIGHT FOR DINING OR LIVING ROOMS.

THE HIGHEST MECHANICAL INGENUITY COMBINED WITH ORNAMENTAL BEAUTY--THE NEWEST OUTPUT FROM THE WELSBACH FACTORIES.

Equipped with new model No. 66 high candle power Welsbach Burner.

Side Pilot By-pass Tube covered with refractory sleeve to prevent bending.

Fourteen-inch Opal Dome Shade.

Polished Brass Embossed Crown 2¼ inches high.

Length of Fixture, 30 inches.

Width of Harp, 4½ inches.

Finished in Polished Brass.

Packed One Dozen to the Case.

List Price, per Dozen, $45 00.

We recommend equipping the No. 6 Harp Fixture with No. 4197 Intensive Brand Mantle, and the No. 306 **F. Q. M.** Clear Glass Air-Hole Cylinder.

Although the 14-inch Opal Dome Shade is standard equipment, we are prepared to furnish Dome Shades in green, pink or yellow (opal lined), and will be glad to quote prices.

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For the Period Ending July 1st, 1905, has been Awarded Contracts for 32 Sets of

Standard Double-Superheater Lowe Water Gas Apparatus.

PARTIAL LIST OF PLACES:

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Plattsmouth, Neb.	**Lansdale, Pa.**	**Houston, Tex.** (2d contract).
Detroit, Mich. (2d contract).	**New Britain, Conn.**	**Hamilton, O.** (2d contract).
Springfield, Ills.	**Ludington, Mich.**	**Indianapolis, Ind.** (2d contract).
Oneonta, N. Y. (2d contract).	**New York,** Mutual Co. (2d contract).	**Hazleton, Pa.**
Pottsville, Pa. (2d contract).	**St. Louis, Mo.** (4th contract).	**Mahanoy City, Pa.**
Evansville, Ind. (2d contract).	**Sioux City, Ia.** (3d contract).	**Nanticoke, Pa.**

TOTAL SETS TO JULY 1ST, 1905, ... 585
TOTAL DAILY CAPACITY TO JULY 1ST, 1905, . 455,980,000 CU. FT.

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Established 1858. Incorporated 1890.
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Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

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FLEMMING GENERATOR GAS FURNACE

Brooklyn Fire Brick Works,

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An Analysis of the Principal Gas Undertakings in England, Scotland and Ireland. Being the 36th year of publication. Compiled and arranged by JOHN W. FIELD, Sec'y and Gen. Mgr. of The Gas Light and Coke Company, London. Price, $5. For Sale by A. M. CALLENDER & CO., 42 Pine St., New York City.

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Modern Coal Gas Benches,

With either Horizontal or Inclined Retorts, Half-Depth and Full-Depth Recuperative Furnaces.

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STANDARD BENCH IRONWORK.

Linings for Water Gas Apparatus, High Grade Fire Brick of All Shapes and Sizes, Ground Fire Clay, Ground Fire Brick in Bulk or in Barrels.

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A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick

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In Kegs, 100 to 200 " " 6 " "
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We are the Exclusive Agents *for the* Mitchell Patent Benches, *Constructed with Half or Full Depth Furnaces, to Burn either Coal or Coke, and Arranged for Front or* Rear Clinkering. The Mitchell *is the* Original Coal Firing Bench. *We also Erect Plain Benches with* One to Six Retorts.

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These are the only machines that will draw or charge simultaneously 3 or 4 retorts (vertically) and handle from 42 to 60 retorts in from 25 to 30 minutes, lid opening and closing and filling of furnaces included.

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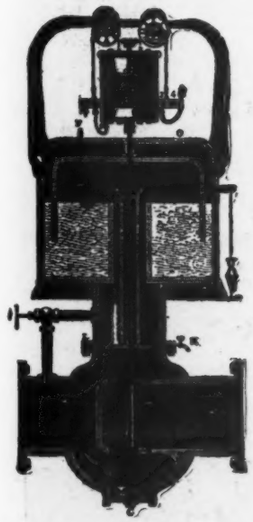

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Automatic, Balance, High Pressure and Service Governors,

Roots Improved Gas Exhausters,

Iron Sponge, Purifying Material for Gas Purification Jones Jet Photometers Pressure Registers, etc.,

INSTALLATION OF SMOKELESS TAR BURNING SYSTEM,

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Wide Experience in High Pressure Installation and Extension,

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Triple, Double and Single=Lift Gasholders,

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Oil and Water Tanks, Purifier Covers, General Plate Metal Work, and Steel Water Towers.

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STRICTLY High Grade. . . . .
Carefully Prepared.
For Gas Making or
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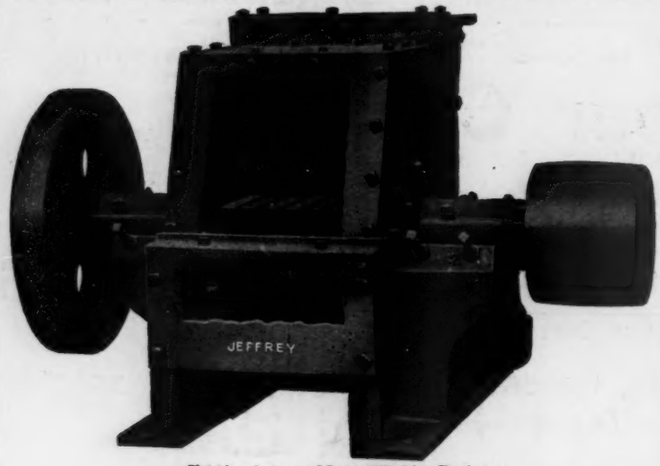
WE ARE READY
TO DEMONSTRATE THE SUPERIORITY
OF
JEFFREY PULVERIZERS
By
FREE CRUSHING TESTS.



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A Few Strong FEATURES:
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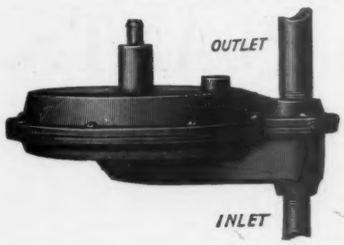

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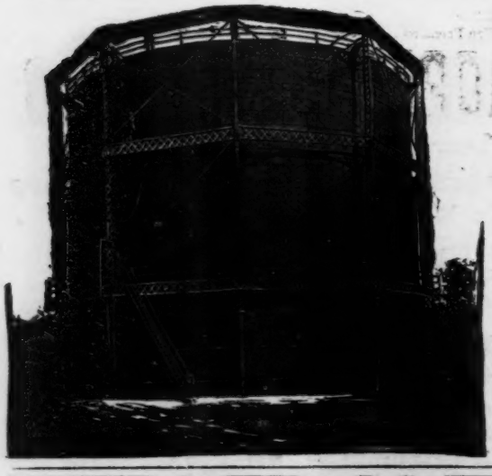

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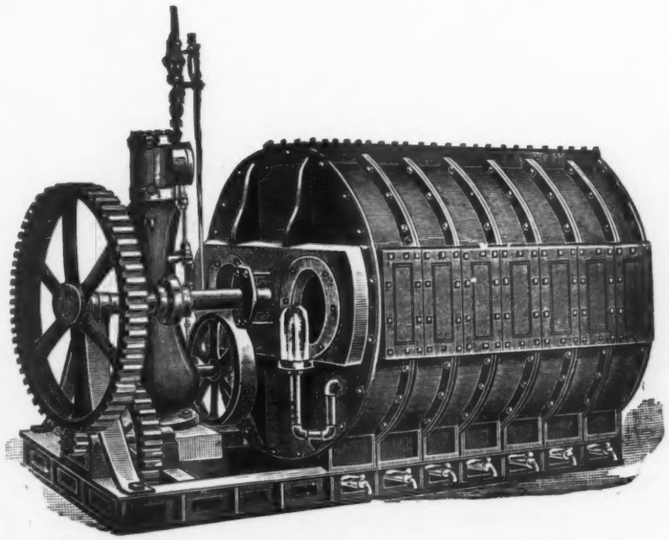

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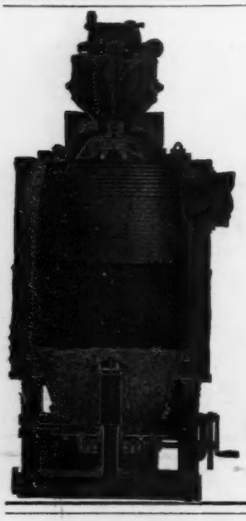

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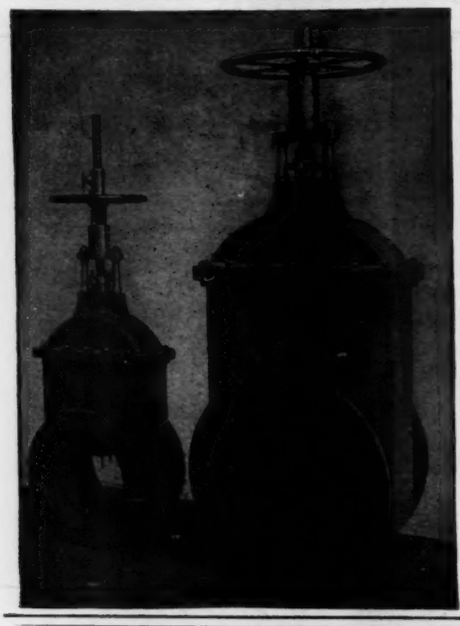

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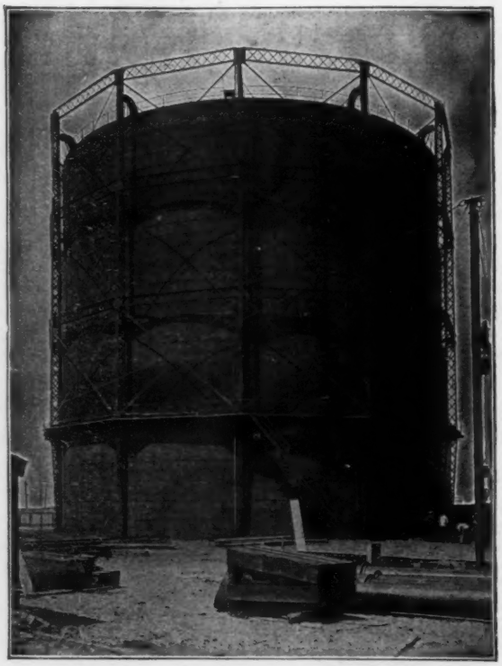

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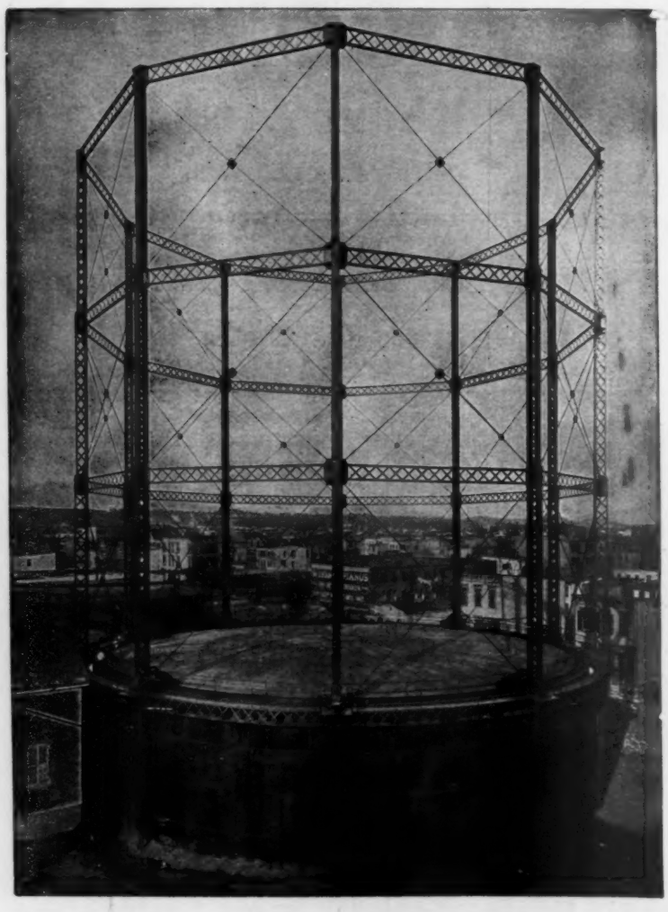

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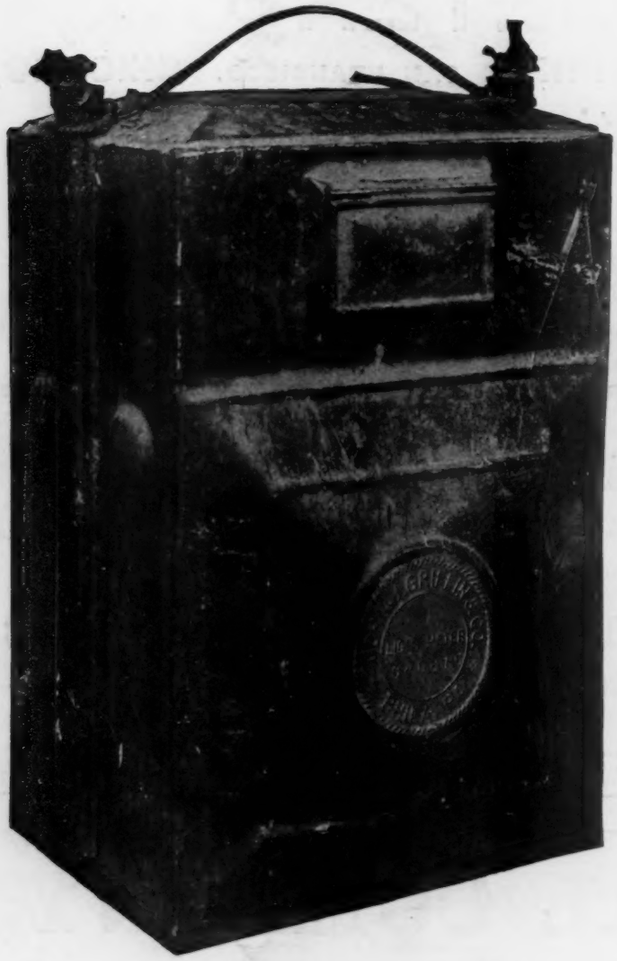

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